



U.S. AIR FORCE



# Upper Longeron BAMF Simulation

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**A-10 Analysis**

**U.S. AIR FORCE**

DISTRIBUTION STATEMENT A: Approved for public release:unlimited distribution  
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# Background



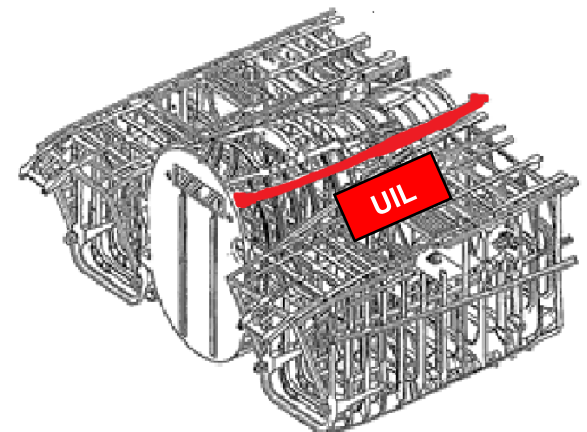
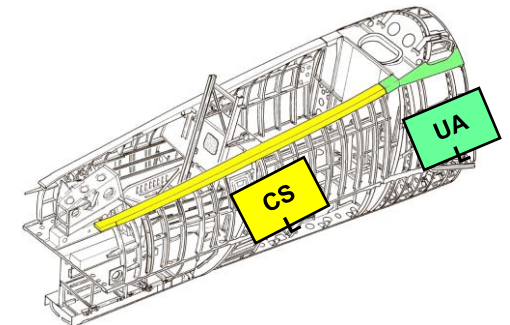
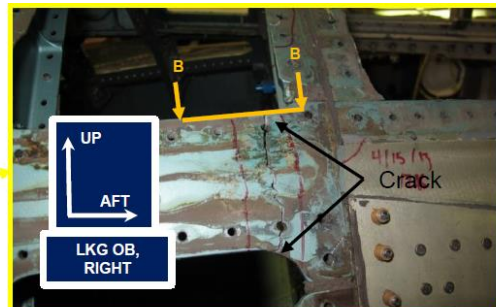
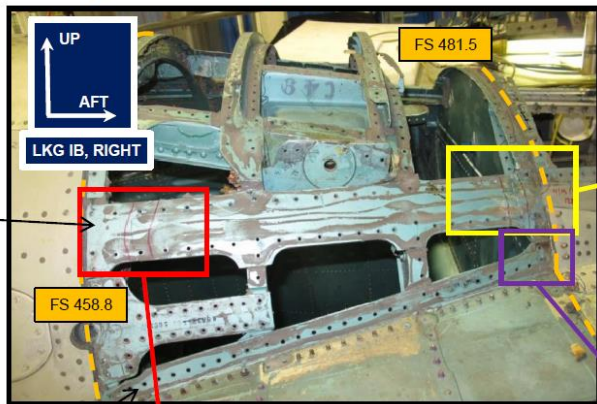
- On Nov. 2<sup>nd</sup> 2007, a military fighter failed in flight due to a failure of the canopy sill longeron (CSL)
- An IRT is in process to evaluate the structural integrity of the structure, focusing first on the upper longeron structure (including CSL)
- The A-10 program was asked to perform an independent evaluation of some critical locations along upper longeron structure
- Evaluation included development of 3D models, FEM work, AFGROW model development, and a risk assessment



# Fatigue Test Failure



- During most recent fatigue testing, several failures were found, with UIL severed in multiple locations

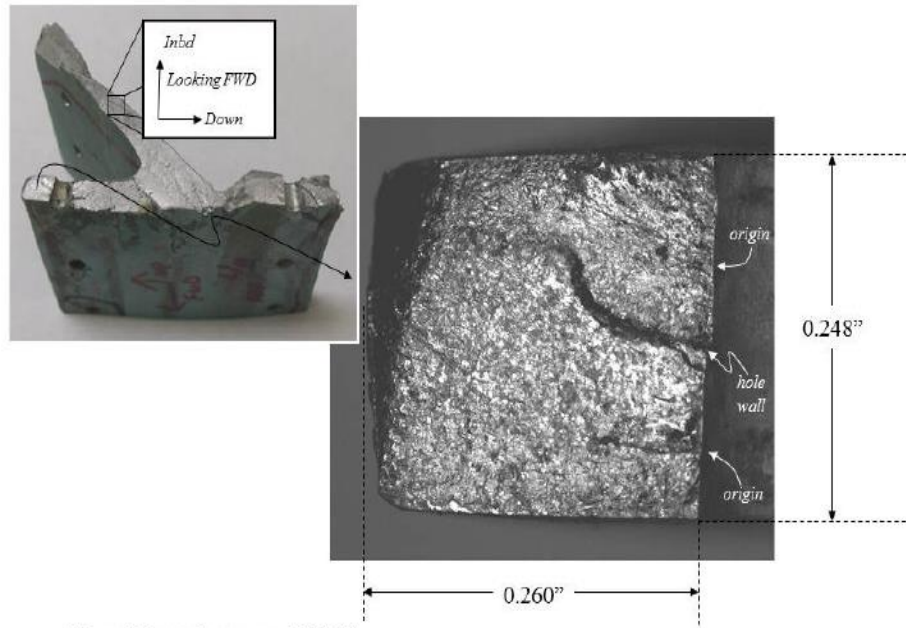




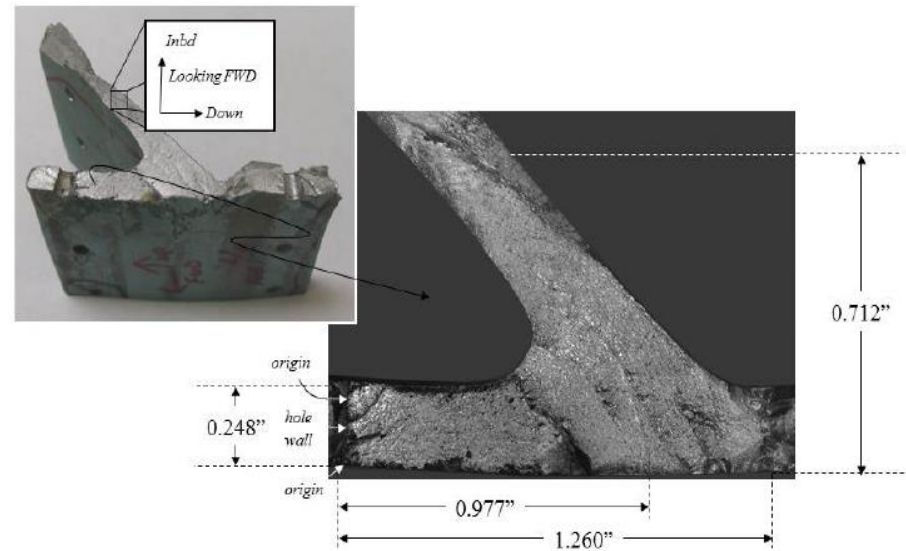
# Fractography



AA00004-SP02\_FAL1\_D1



AA00004-SP02\_FAL1\_D2





# Why BAMF



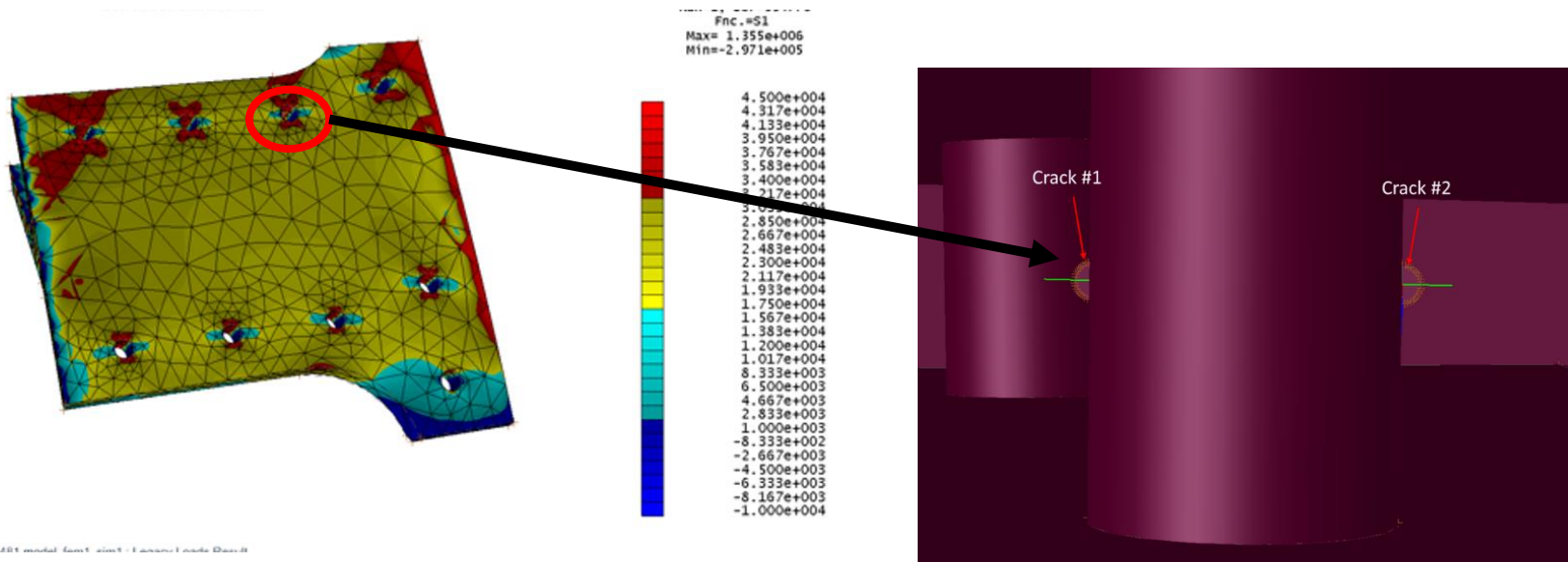
- Very little information was provided aside from overall pictures
- Needed ability to correlate to test result if possible
  - Only had hrs to failure and the spectrum
- Global FEM and legacy stress reports used to get stress distribution in UIL
- BAMF provided another tool to provide confidence in fracture mechanics model





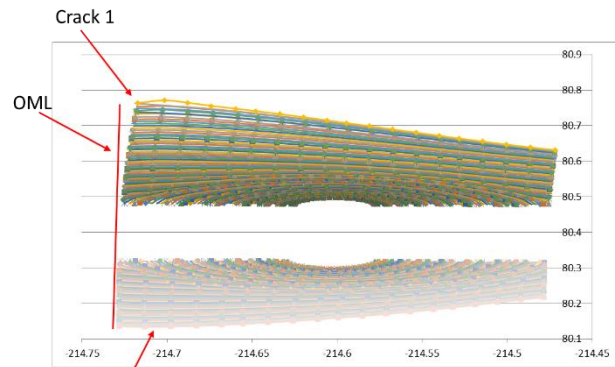
# Model

- Initial state was .01” radius semi-circular flaw at mid bore of critical hole
- Stress distribution from FEM results in NX
  - Adjusted to provide stress state that could produce failure

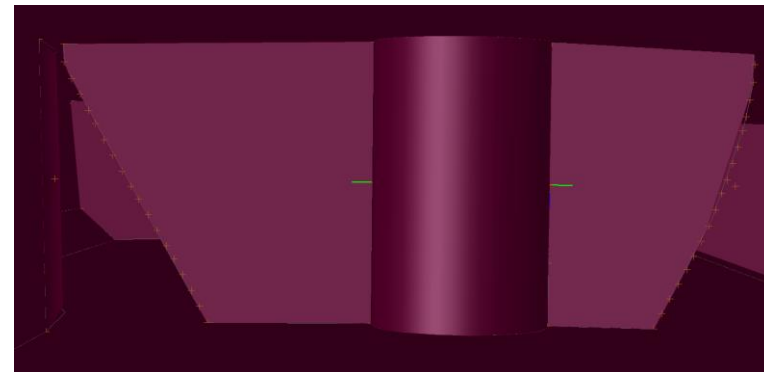
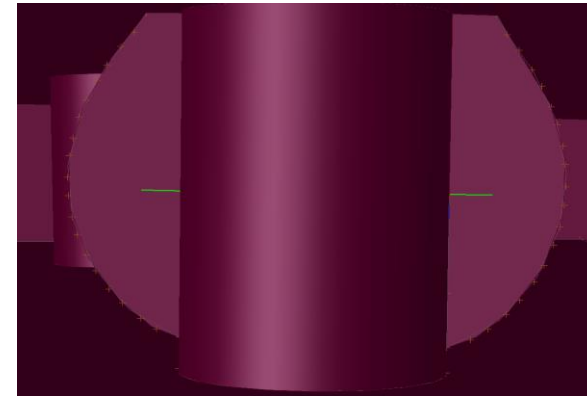
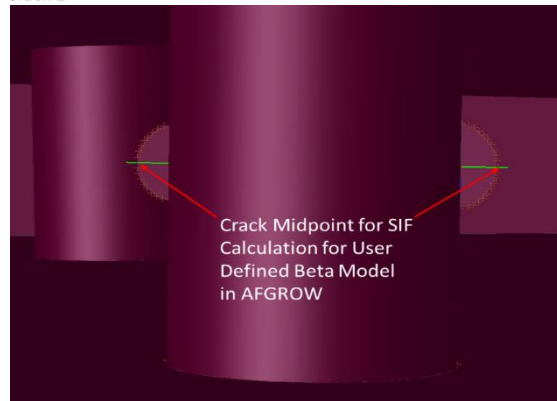




# Crack Evolution

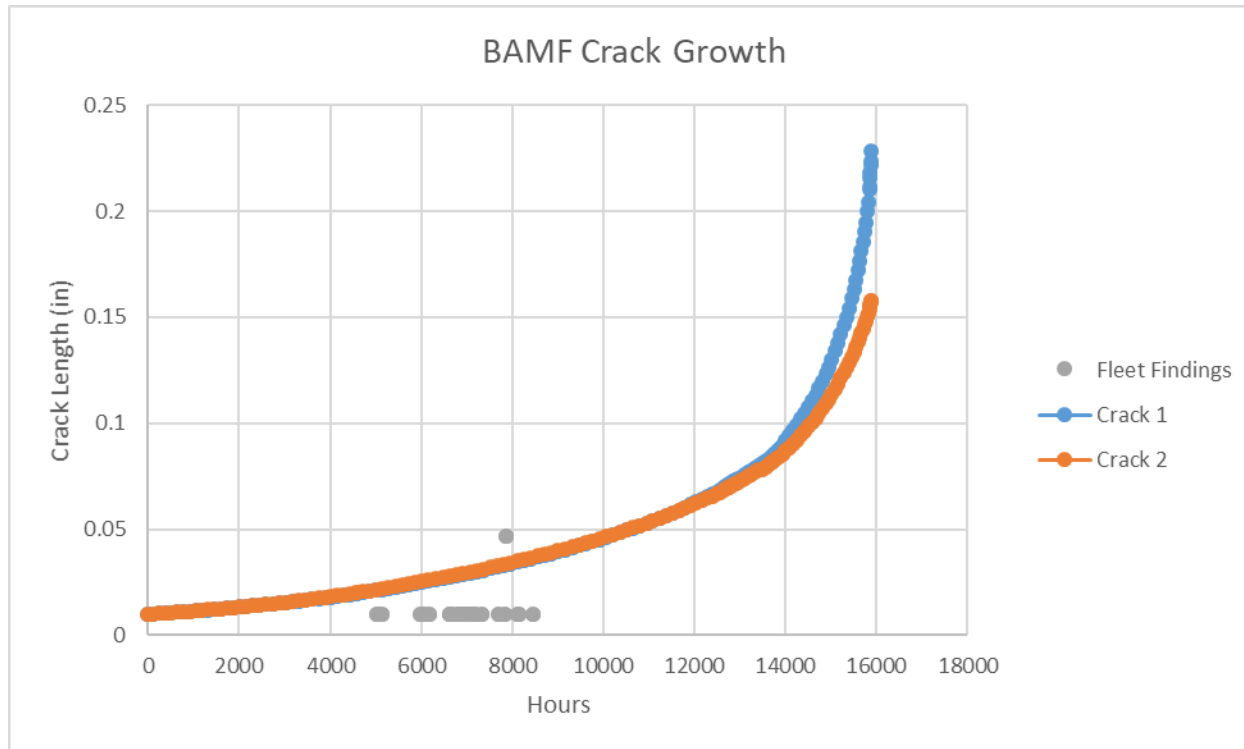


Crack 2





# Crack Growth







# Results



- **BAMF model matched crack shape and life very closely (within a few hundred hours)**
- **Beta values for the crack mid point used for user-defined AFGROW model**
- **SOLR chosen for Generalized Willenborg retardation model provided good results and was within appropriate values for aluminum (~3)**
- **End result: BAMF results provided confidence in fracture mechanics model used to perform risk assessment**