

Ogden Air Logistics Center



U.S. AIR FORCE

Next Generation Crack Growth Predictions - Coupled Finite Element Modeling and Crack Growth

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What happens when you intertwin AFGROW 's
Plug-in capabilities with S Check?



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BAMF

Broad Application for Modeling Failure

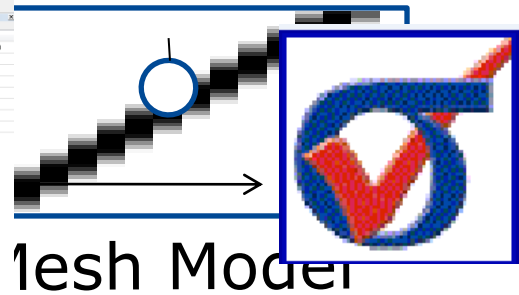
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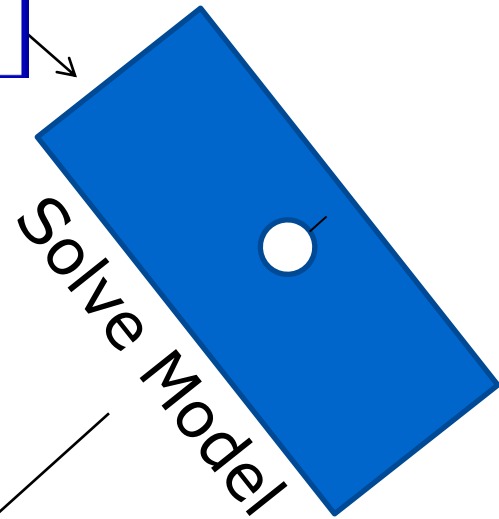
What does BAMF do for you?



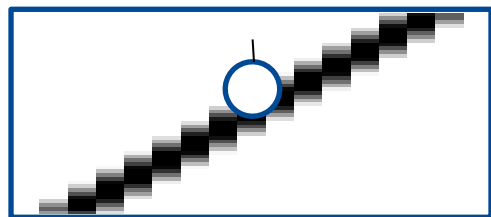
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Mesh Model



Solve Model



Extract Stress Intensities

Import Model

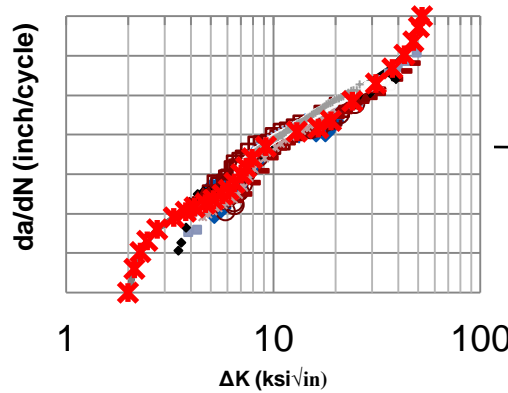


What does BAMF do for you?



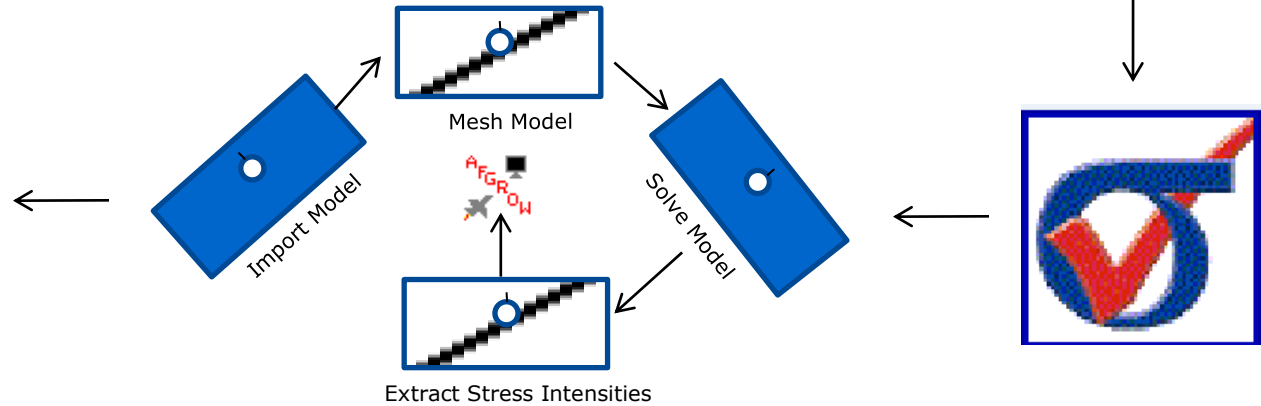
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$$a = K/\sigma$$



→ New Crack Lengths

Insert movie






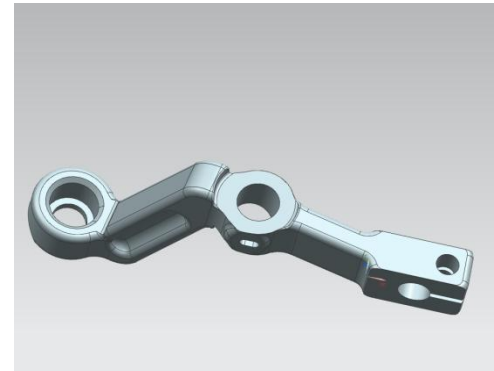
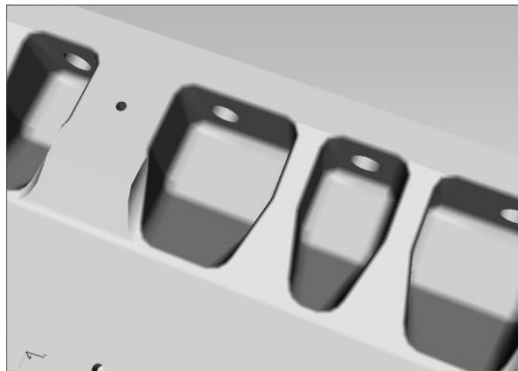
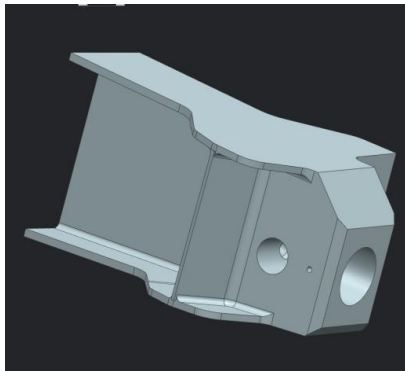


Building of Code



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-  **Code built in VB2008 Express using AFGROWBetaPlugin (ref Brent Lancaster)**
-  **Development took approximately 6 months (Learning curve for AFGROW/SC commands)**
-  **Hardest part was developing the code and model to account for all possible scenarios of crack growth and model development.**





Benefits of BAMF



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INFOCON 3 UNCLASSIFIED EPSON Beamer

Form1

Updating elements...

o Crack Length 0.05 o Beta 1.79
o Crack Length 0.05 o Beta 2.1011

c	Kc	a	Ke	ct
0.05	7084	0.05	8327	0

K extraction a=0.05 c=0.05

Copy Data to Excel Abort AFGROW Run

running Kc extraction

Y X

BAMF

BAMF

BAMF




BAMF

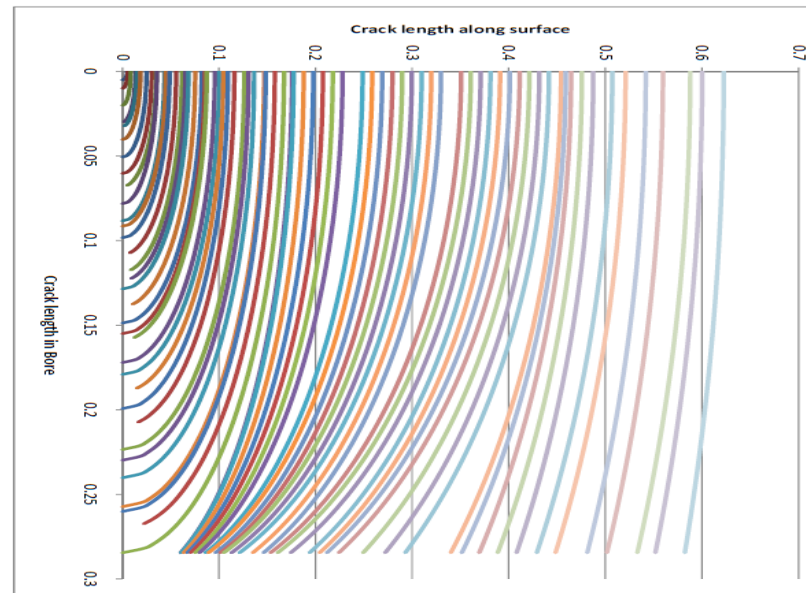
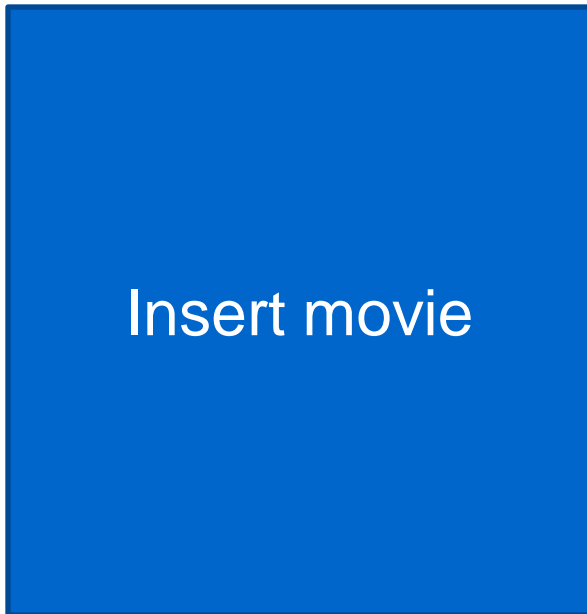


More Features of BAMF



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-  Allows for a/c to be constant or variable
-  Graphics to help understand how stress is redistributed in the part as the crack grows
-  Graphic that shows the beach marks as the crack grew through the part





Building a BAMF Model in StressCheck



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Keys to not making the model fail

- Have me build your model!
- Sets, Sets, Sets
 - CRACKFACE; CRACKFRONT; AUTOMESH; NUCLEATION; THICKNESS
- Define BCs as Sets
- View for stress plot defined as “Stress”
- Plot parameters for stress plot saved as Stress
- Saved with No Mesh
- Currently Save as OffsetHole.sci



Variability in Validation of BAMF Solutions



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BAMF

Building of FEA Model (StressCheck)

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Selection of K_a and K_c from StressCheck Extractions

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Determining “Far Field Stress”

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Material File (AFGROW)

BAMF

Failure Criteria

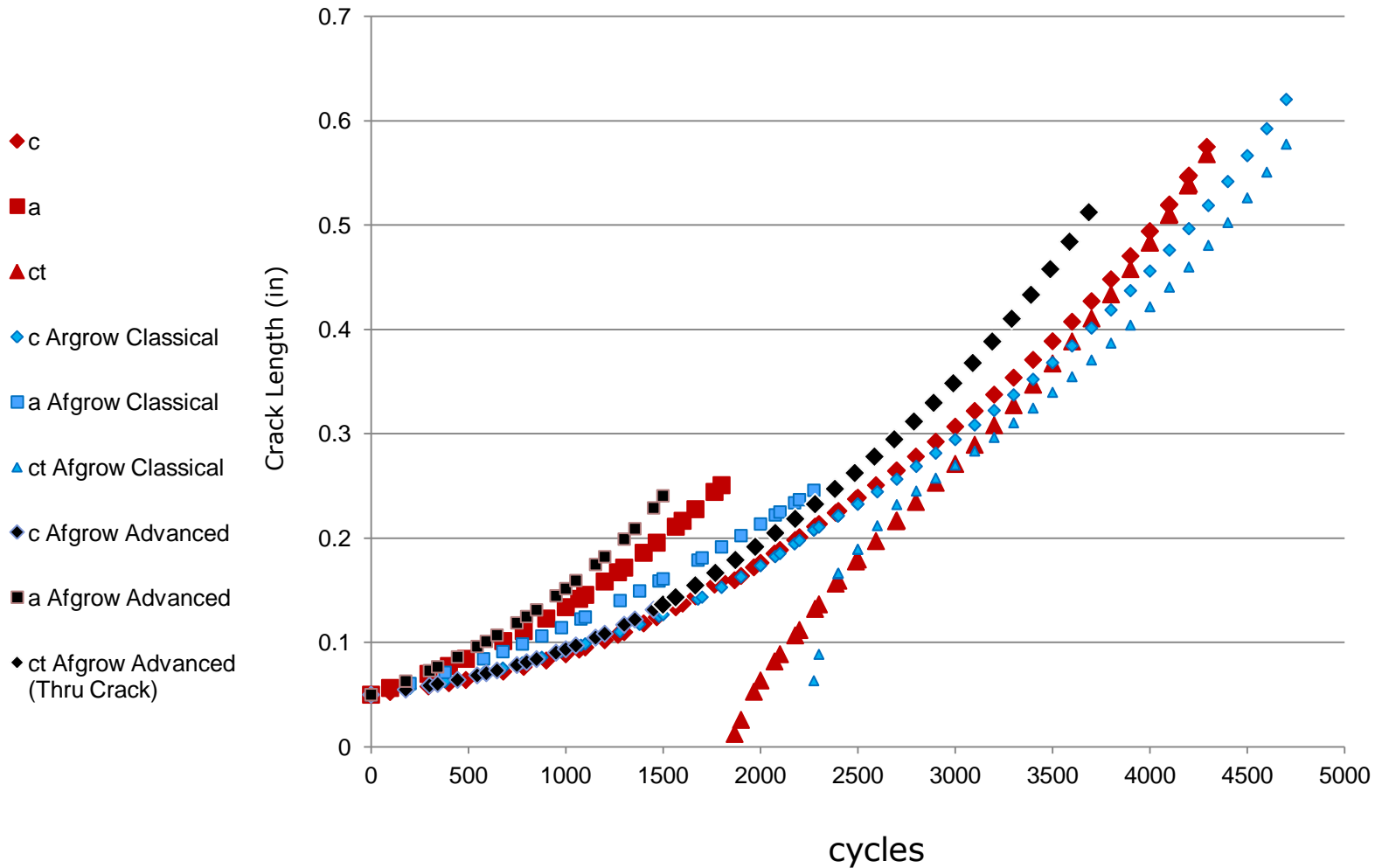


Comparison to AFGROW

B=2 W=5 t=0.25 D=0.25
Const Ampl SMF 30



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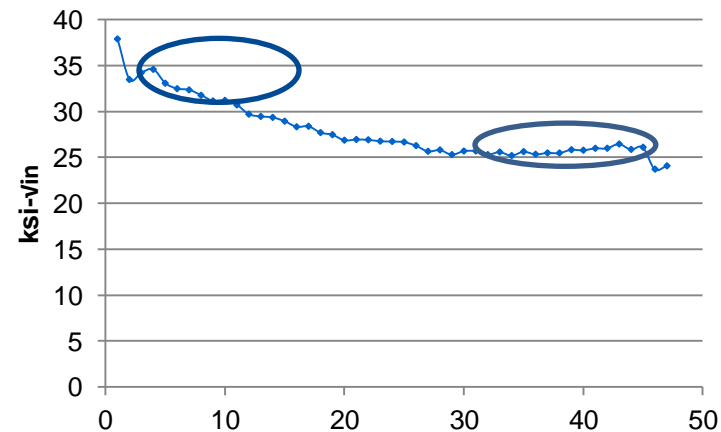
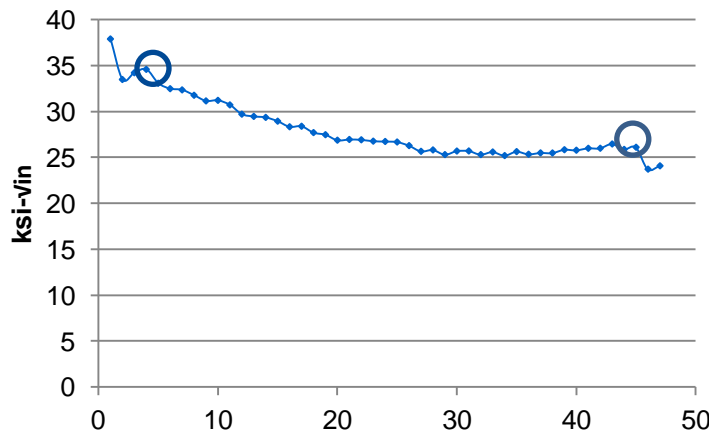


Selection of K



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- Selection of K's is not a trivial manner!
- As aspect ratio changes the concentration of points along the curve change (Zach and Cordell)
- Current method is aimed at attempting to capture the local max and local min
- Number of points can be changed in the VB code to change the aggressiveness of the model



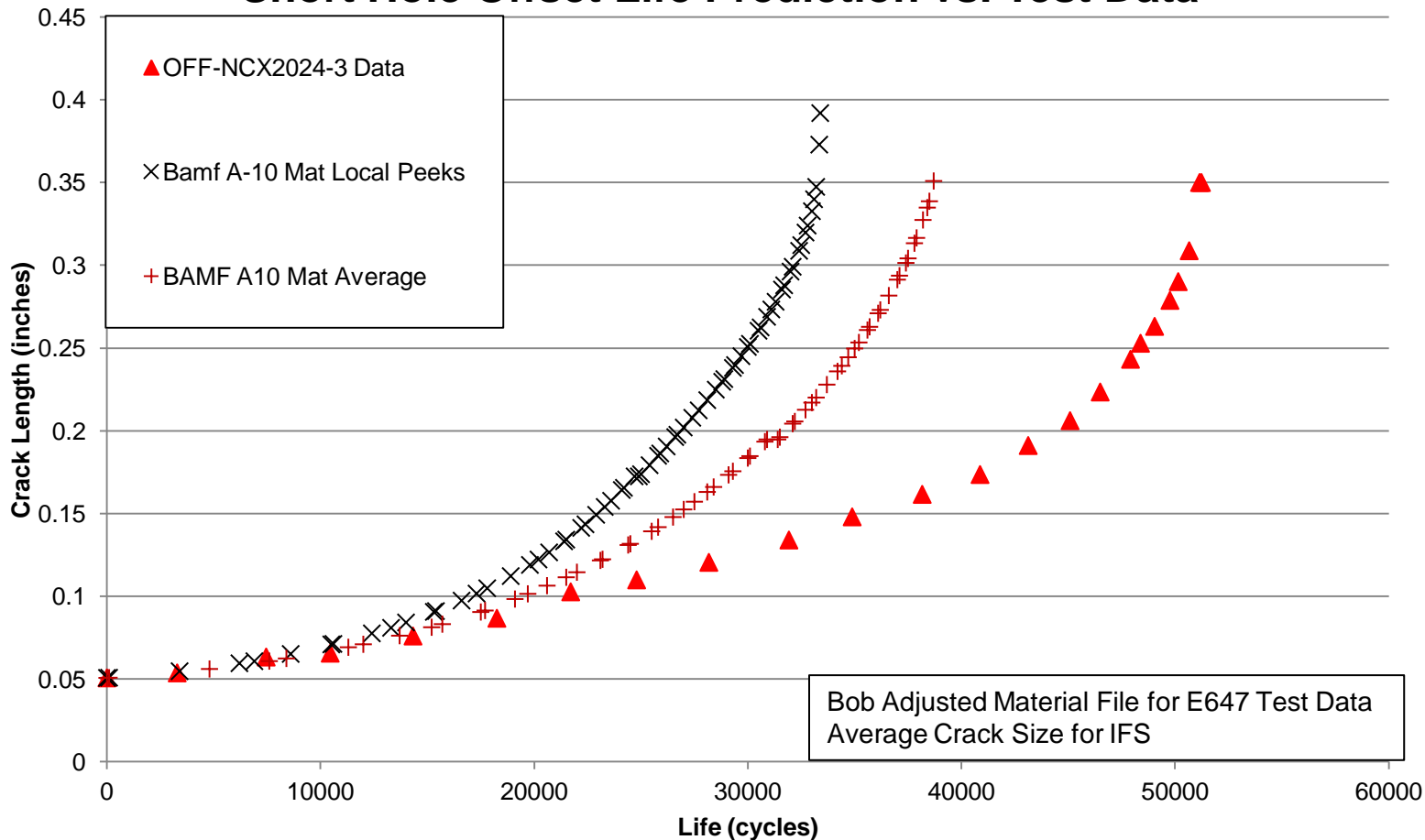


Selection of K



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Short Hole Offset Life Prediction vs. Test Data





Material File Selections



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- **Subtle Differences in the Da/DN curve can drastically change the shape of the curve**
- **Not BAMF dependent but worth noting when matching data to test results**

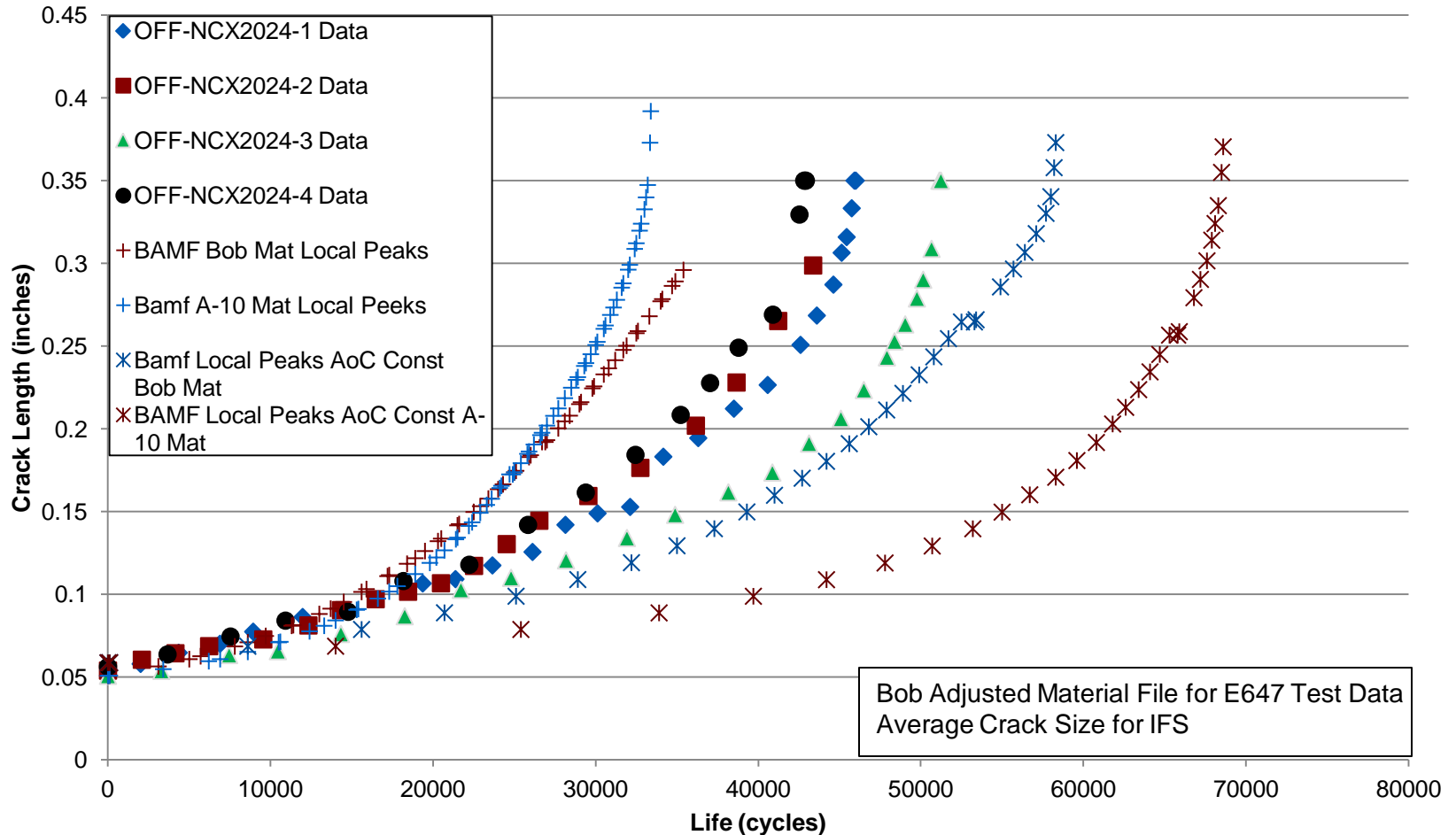


Material File Selections



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Short Hole Offset Life Prediction vs. Test Data





Discussion of things to be worked on



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- **Through thickness failure**
- **Failure criteria**
- **Transition into obscure geometries**
- **Dealing with small crack lengths <0.05 in**
 - **Sets (THICKNESS)**
 - **AFGROW 5%**
- **Mesh refinement tools (Local Curve refinement)**
- **Multi-cracks that are not in the global planes**