Countersink Bushing Repair-Lower Wing Skin T-38

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Overview

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- Issue
- T-38 standard countersink fastener repairs
- Countersink Macro
- Comparison of StressCheck™ results to T-38 standard AFGROW solution
- Conclusions/Discussion

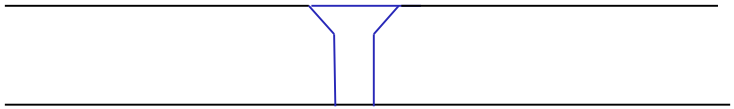
Issue

- **Is the current approach to fastener repairs appropriate?**

T-38 Standard Repairs

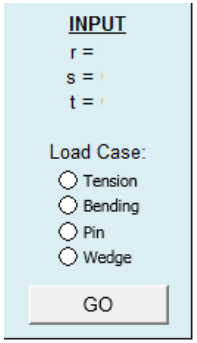
- **NDI indication is drilled out in 1/64 inch increments until the indication is removed**
- **Oversize fastener and bushing repairs are common**
  - **Involves drilling out indication and installing an oversize fastener or countersink bushing in the lower wing skin**
  - **Bushing with fastener installed**

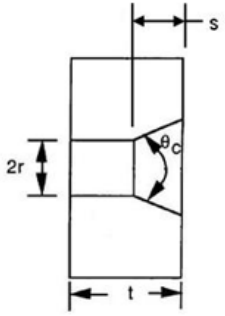
  - **Oversize fastener installed**



T-38 Standard Approach Beta Correction Macro

- Developed by Southwest Research Institute
- Calculates beta correction factors based on geometry of countersink
- Use in connection with AFGROW to allow modeling of the countersink fastener/bushing
- Only effective when radius over thickness (r/t) is less than 2.5





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Process

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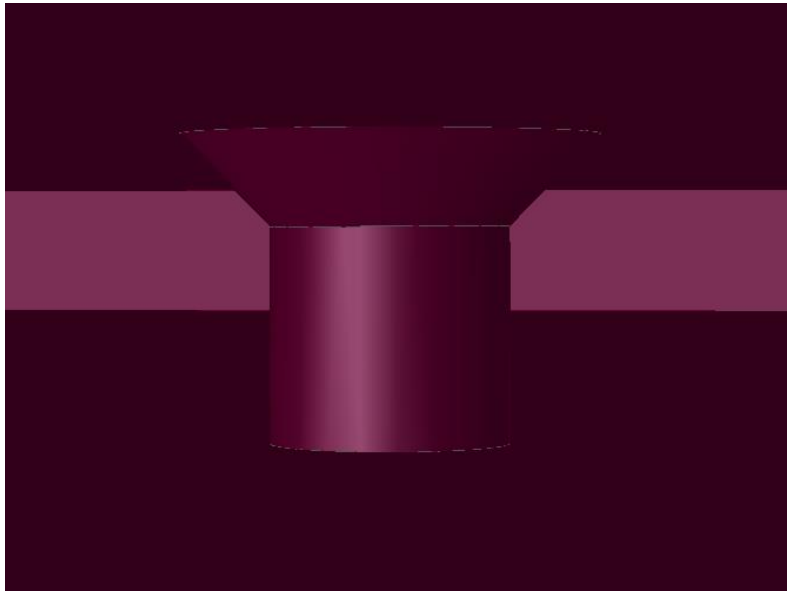
- A parametric model of a centered countersink fastener hole was built in StressCheck™; changes in diameter and thickness of plate were explored
- Modeled same solution sets using T-38 standard approach
- Plotted Total Beta vs Crack Length comparison of StressCheck™ and T-38 standard approach
- Plotted Crack Length vs Life of StressCheck™ and T-38 standard approach

Thick Plate Standard Geometry

- Thickness: 0.34 in
- Dia: 0.2651 in
- Countersink Dia: 0.463 in
- Countersink Depth: 0.102 in

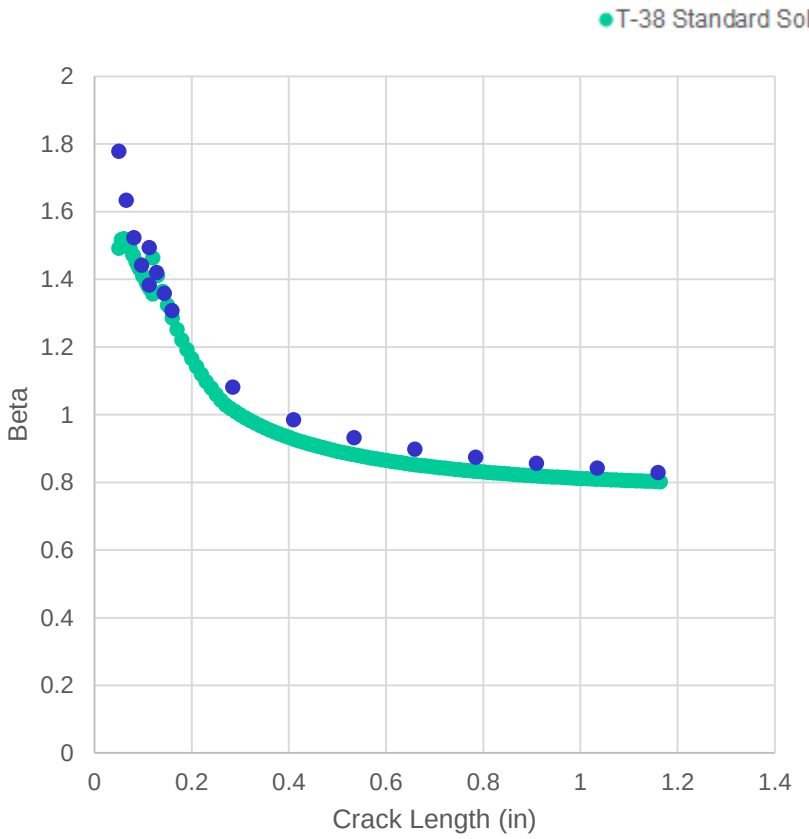


- Thickness: 0.238 in
- Dia: 0.2651 in
- r/t_{total}= 0.556
- CSK Beta Correction:

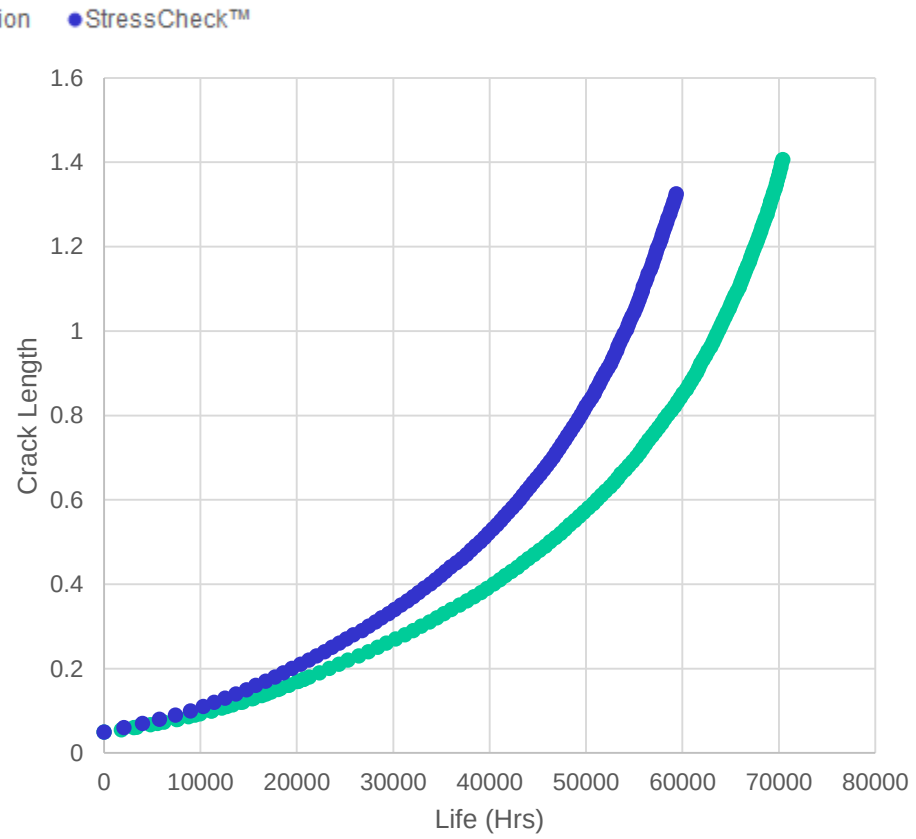
Crack Length	βcs
0	1.1369
0.0265	1.1232
0.053	1.1095
0.0795	1.0958
0.106	1.0821
0.1326	1.0684
0.1591	1.0548
0.1856	1.0411
0.2121	1.0274
0.2386	1.0137
0.2651	1

Thick Plate Standard Geometry

Beta vs Crack Length

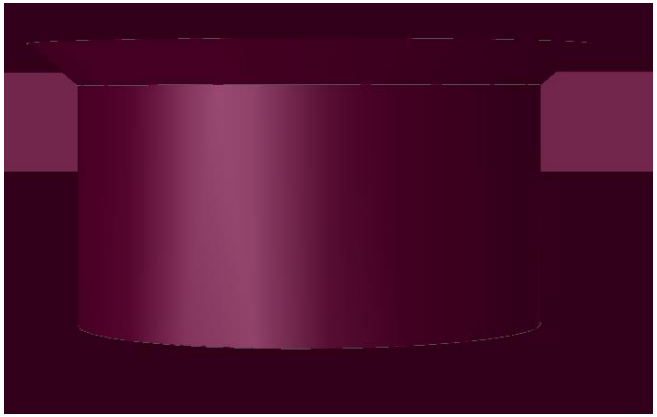


Crack Length vs Life



Thick Plate with Bushing Repair

- Thickness: 0.34 in
- Dia: 0.563 in
- Countersink Dia: 0.682 in
- Countersink Depth: 0.05 in

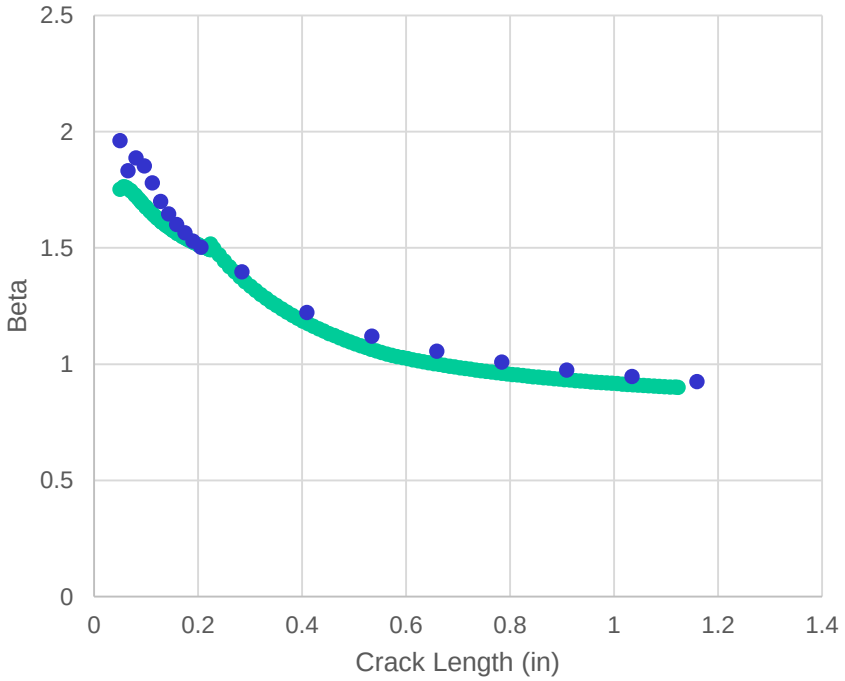


- Thickness: 0.29 in
- Dia: 0.563 in
- r/t_{total} =0.97
- CSK Beta Correction:

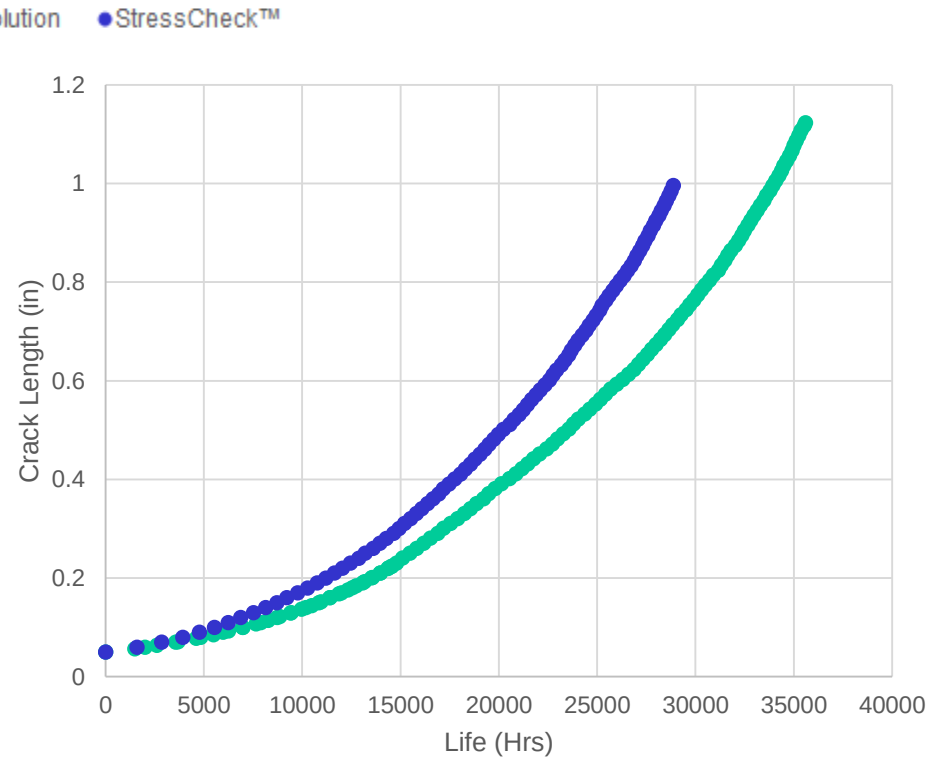
Crack Length	β_{cs}
0	1.0871
0.0563	1.0784
0.1126	1.0697
0.1689	1.061
0.2252	1.0523
0.2815	1.0435
0.3378	1.0348
0.3941	1.0261
0.4504	1.0174
0.5067	1.0087
0.563	1

Thick Plate with Bushing Repair

Beta vs Crack Length

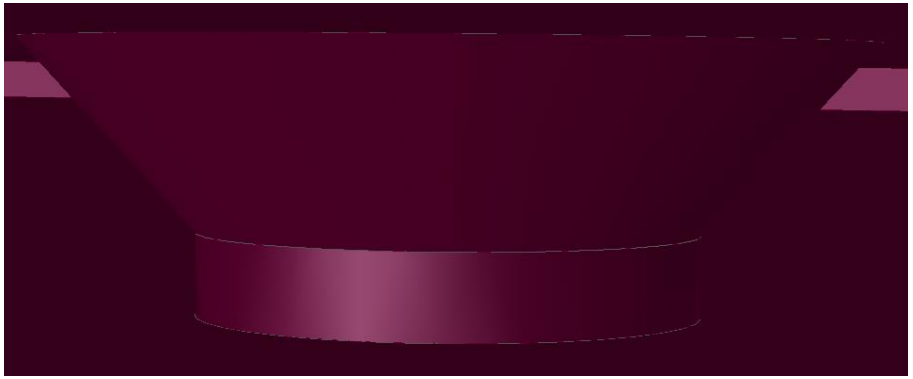


Crack Length vs Life



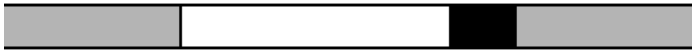
Thin Plate Standard Geometry

- Thickness: 0.11 in
- Dia: 0.2026 in
- Countersink Dia: 0.342 in
- Countersink Depth: 0.077 in



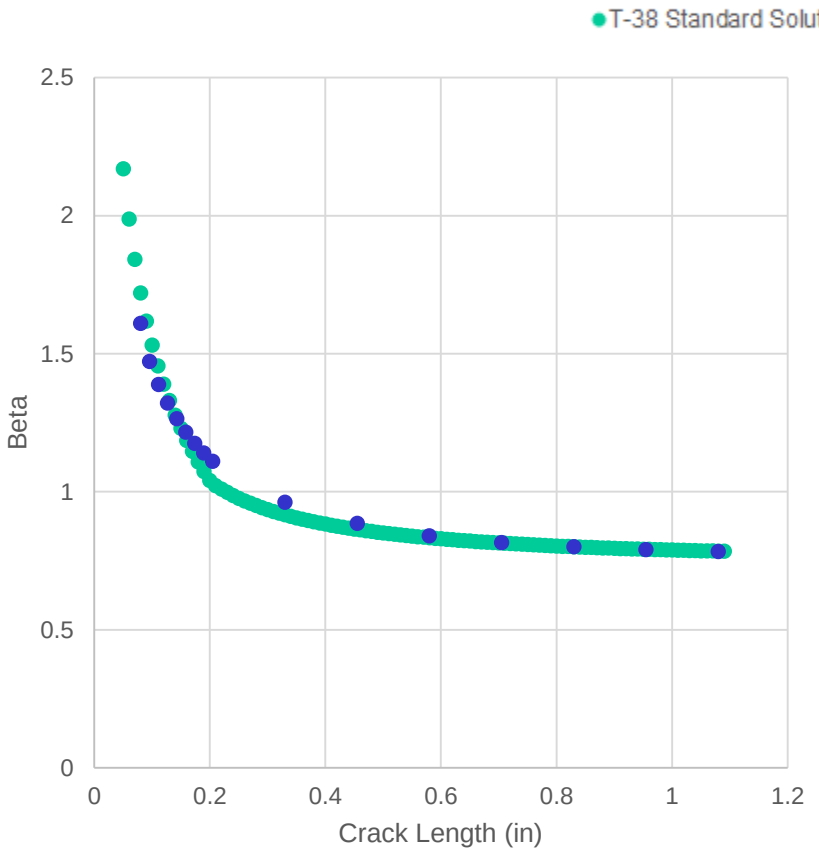
- Thickness: 0.033 in
- Dia: 0.2026 in
- r/t_{total} =0.92
- CSK Beta Correction:

Crack Length	β_{cs}
0	1.3241
0.0203	1.2917
0.0405	1.2593
0.0608	1.2269
0.081	1.1945
0.1013	1.1621
0.1216	1.1296
0.1418	1.0972
0.1621	1.0648
0.1823	1.0324
0.2026	1

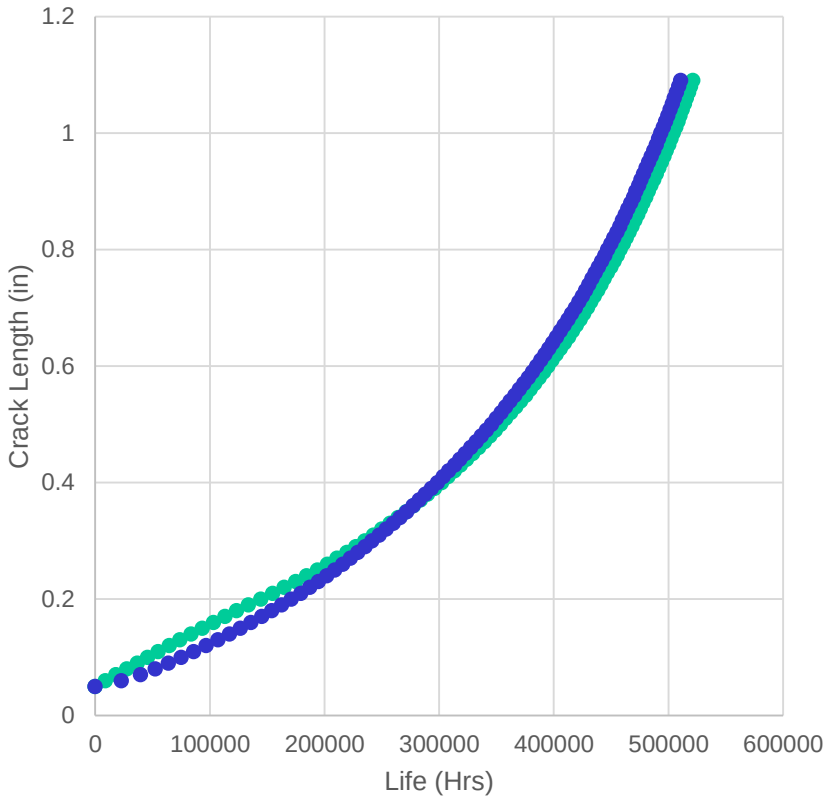


Thin Plate Standard Geometry

Beta vs Crack Length

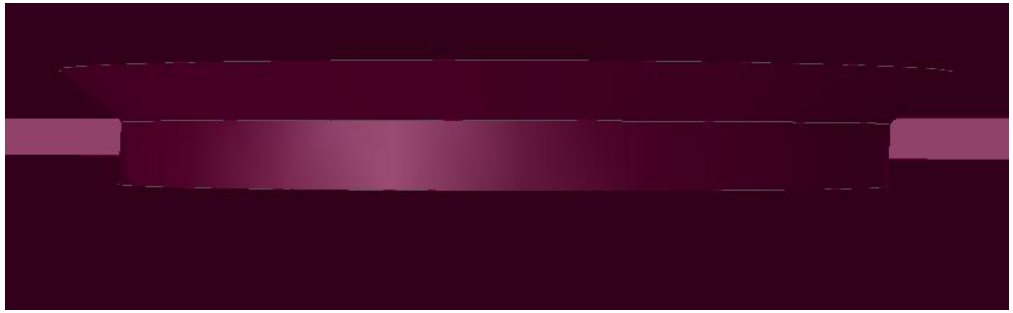


Crack Length vs Life



Thin Plate with Bushing Repair

- Thickness: 0.11 in
- Dia: 0.75 in
- Countersink dia: 0.869 in
- Countersink depth: 0.05 in

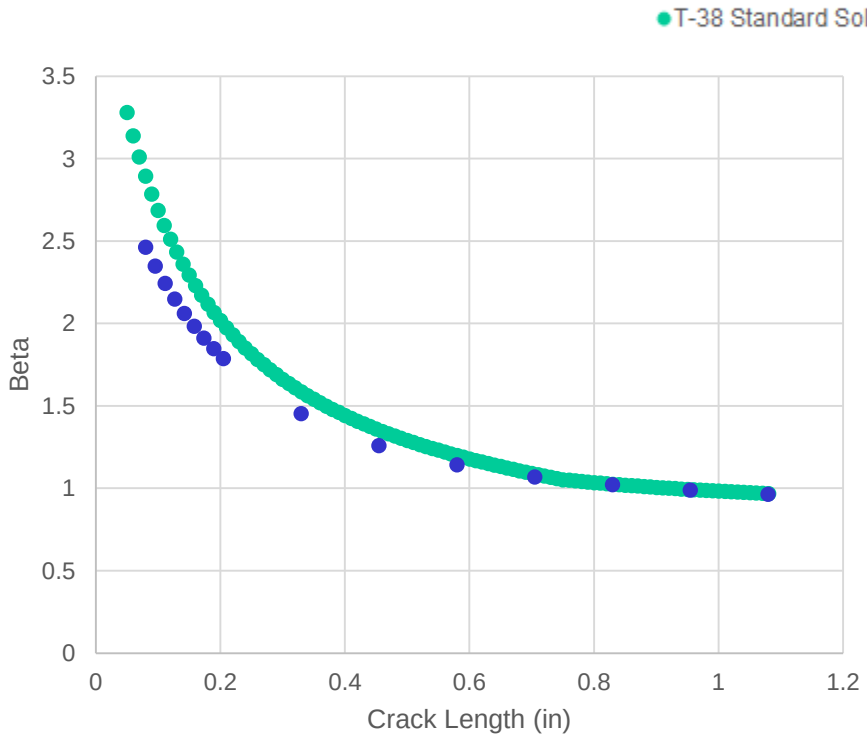


- Thickness: 0.06 in
- Dia: 0.75 in
- $r/t_{total} = 3.41$
- CSK Beta Correction:

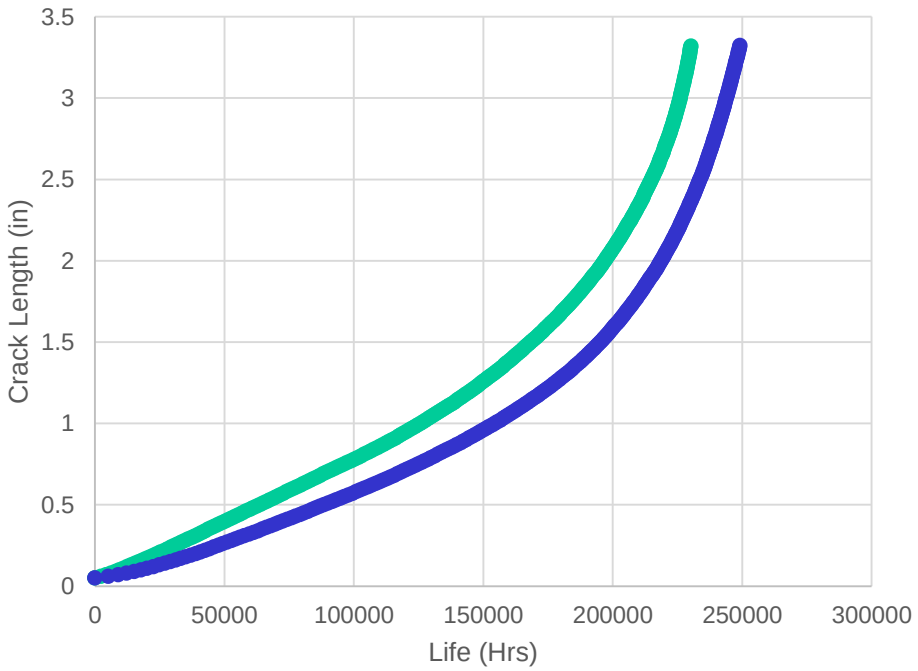
Crack Length	β_{cs}
0.001	1.251
0.075	1.2259
0.15	1.2008
0.225	1.1757
0.3	1.1506
0.375	1.1255
0.45	1.1004
0.525	1.0753
0.6	1.0502
0.675	1.0251
0.75	1

Thin Plate with Bushing Repair

Beta vs Crack Length



Crack Length vs Life



Conclusion

- **Current analysis approach for bushing repairs appears to be appropriate**
  - **Slight differences in life are not significant enough in these cases to drive a shorter inspection interval**
- **If radius over thickness (r/t) is greater than 2.5 for a fastener or bushing repair, then StressCheck™ can be employed if needed**