Fundamentals of ALT

Fred Schenkelberg







Do you know when your product will

Basic ALTs



Time Compression



Stress to Life Relationship



Acceleration Model

Time Compression



Works when item is exercised infrequently

Cycle of use occurs in repeatative manner

Easiest acceleration factor derivation

Use more often than normal



What element of a alarm clockis suitable for time compression?

Stress to Life Relationship



Based on previous work

Based on previous work

If we do this amount of stress, and it survives, it will last 10 years...

Generally used as short cut to full ALT experiment based on previous full ALT

85°C / 85 RH orginally for plastic enclosure modules sealing around lead frame.

What element of an alarm clock would this ALT approach apply?



Acceleration Model



Someone worked out the details

Arrhenius rate equation is an example

Tend to be single failure mechanism

Wide range of models in the literature

Which model would work for an alarm clock ALT?



Do We Accelerate All Failure Mechanisms?

Advanced ALT



Step Stress with Model

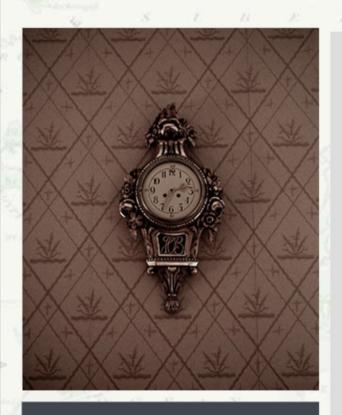


Create a Model



Degradation

Step Stress with Model



Works well with accumulated damage situations

Works well with accumulation of damage proportional to applied stress

Need broad range of stress to same failure mechanism to avoid multiple failure mechanisms from occuring

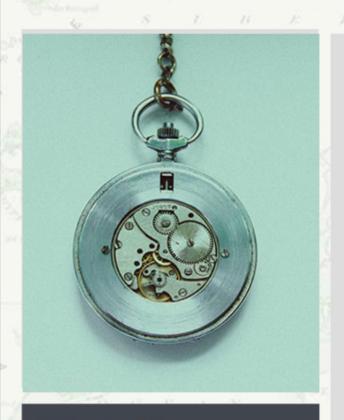
Pretty quick to create failures

Regression analysis a bit more tricky

Would step stress ALT work for a drop test?



Create a Model



A time to failure relationship with stress

Run multiple stress levels and get failures

Regression analysis for the surface of time to failure distributions and different stress levels

Suitable for complex or new materials or constructions

What is the 4:2:1 guideline?



Degradation ALT



Why wait for failures?

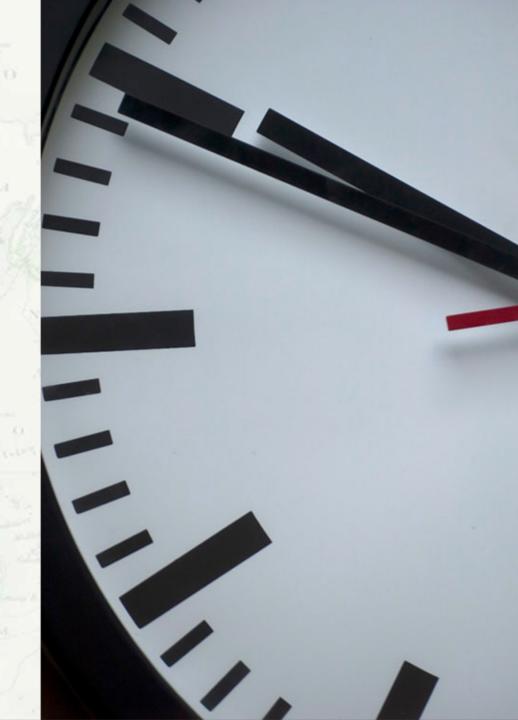
Suitable for wear or decay of a function

Repeated measures does complicate math a bit...

Suitable when there is not a 'hard' failure

Allows for analysis when defintion of failure changes

How would you plan an ALT for bicycle brake pads?



How well are your ALTs working?

What Could Go Wrong?



Use vs Test Condtions

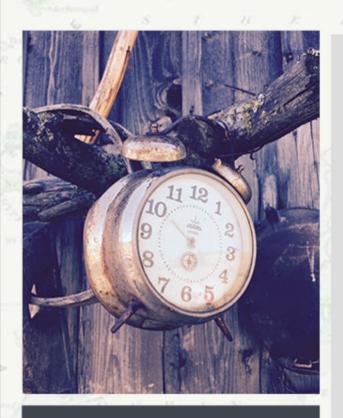


Failure Mechanism Focus



Assumption checking

Use vs Test Conditions



Every step away from actual use increases risk

Stay as close to use conditions as possible

Include variability of use applied stress

Stresses may require a sequence of application

Stresses may not be independent

Failure Mechanism Focus



Understand what really is going on to improve results

ALT with one failure mechanism is best

Pursuing more than one is trickier

Remember that all failure mechanism are at play all the time

What for unexpected failures during testing

Assumption Checking



You know what they say... when you assume...

Check all assumptions

Are the failures in the test the same failure mechanism we're expecting?

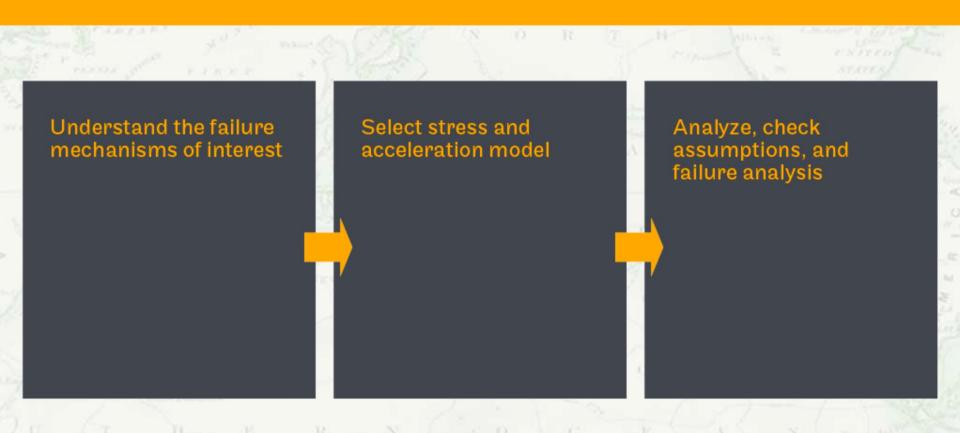
Is the fitted distribution the right fit?

Is this the right model? How do we know?

Models, use, regression, etc all have assumptions

How else have you seen a ALT go bad?

Creating an Estimate of Reliability Performance Creates ALT Value



More Information

Visit AccendoReliability.com

Let me know if you have any questions.

Check out the reliability engineering podcast network at Reliability.FM

Continue to explore your testing and make improvements.