



Fundamentals of ALT

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How long
will it last?



Is it reliable
enough?

Which option
will have
fewer
failures?



Do you know when
your product will

Basic ALTs



Time Compression



Stress to Life Relationship



Acceleration Model

Time Compression



Use more often
than normal

Works when item is exercised infrequently

Cycle of use occurs in repeatative manner

Easiest acceleration factor derivation



What element
of a alarm
clock is
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 originally 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 occurring

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



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 definition of failure changes

Why wait for failures?

How
would you
plan an
ALT for
bicycle
brake
pads?



How well are your
ALTs working?

What Could Go Wrong?



Use vs Test Conditions



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

Understand the failure
mechanisms of interest



Select stress and
acceleration model



Analyze, check
assumptions, and
failure analysis

More Information

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