

# Calibrated Accelerated Wear-Out Test (after Larry Edson of General Motors)

To calibrate an accelerated Wear-Out test, three levels of overstress environments are applied to three groups of prototypes or prototype subassemblies. These groups contain different quantities of units under test (UUTs).

- 1) First, establish the (high) stress level at which irrelevant failures just start to occur. This may be the absolute maximum rating from a data sheet, where the device fails on only the second cycle, or where an entirely different and irrelevant failure mode starts to happen. This will be called the “foolish” stress level.
- 2) The highest stress in the test should be approximately 10% below this foolish stress level, to produce relevant failures. This is the smallest group, but at least two UUTs. Expect these to fail soon, so immediately start the second group.
- 3) If parallel testing is possible, simultaneously start a larger quantity of UUTs (ideally twice as many) at a stress level 20% below the foolish stress level. This group will take somewhat longer (more cycles) to fail than the first group.
- 4) Establish the failure mode for all these UUTs as they fail. Use evidence from the physics of failure to establish which form the relation of stress versus life will take. This will most likely be a power series or an Arrhenius relation.
- 5) Perform Weibull Analysis, appropriately suspending dissimilar failures, and get estimates of the characteristic life at these two stress levels. Estimate a tentative relation of life versus stress based on physics of failure and these times.
- 6) Use the tentative life-versus-stress relationship to estimate whether the life requirement will be met. Depending on how hopeful or hopeless this appears, give advanced notice to others. If there is any hope of passing, continue.
- 7) Establish how much project time is available to complete this accelerated test. The third group will use up most of this time and should have at least twice as many UUTs as the second group.
- 8) Based on the tentative relation of life versus stress, the number of test fixtures, and UUT quantity, set this third stress level so that sufficient failures (using the median rank table) occur conservatively within the remaining time available.
- 9) Analyze the third group for failure modes as they fail. When sufficient failures have occurred, perform Weibull Analysis and accurately estimate the characteristic life for all three groups based on all times and failure modes.
- 10) Update the tentative relation of stress versus life based on all the evidence available. Project the life at the intended worst case stress level (including multiple failure modes if appropriate) and compare to the requirement.

