



Design for Reliability and Accelerated Life Testing Course: HALT, Weibull and Reliability Growth



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Introduction:

Design for reliability and accelerated life testing, with HALT, Weibull and reliability growth, is the subject of this 5-day course for product design, test and quality engineering roles, who build a Product Reliability Plan and an Accelerated Life Test Plan for a case product. Manufacturers localising electronic, automotive, appliance or defence products often find weak joints, seals and connectors only through warranty returns, because life targets were never allocated. Nominees already support design reviews or qualification testing and work through modelling builds on test data. CoreConcept Training Center delivers this design for reliability course.

Course Objectives:

- Translate a mission profile and warranty period into product reliability targets and allocate them to subsystems with reliability block diagrams
- Use design FMEA, derating and physics-of-failure models to rank weak points in a new design before prototypes are built
- Plan accelerated life tests with Arrhenius, Eyring, inverse power law and Coffin-Manson acceleration factors without changing the failure mechanism
- Run HALT step-stress sequences to find operating and destruct limits and derive a HASS production screen with a proof-of-screen
- Fit Weibull and lognormal models to test data with suspensions and size zero-failure reliability demonstration tests at a stated confidence
- Track reliability growth with Duane and Crow-AMSAA models and forecast warranty returns from early field data

Target Audience:

- Product and hardware design engineering roles responsible for component selection, derating and design margins
 - Test and qualification engineering roles responsible for environmental, life and stress test plans
 - Quality and reliability engineering roles responsible for product life targets, test data analysis and field return monitoring
 - Supplier and component engineering roles responsible for qualifying purchased parts and sub-assemblies
 - New product introduction engineering roles responsible for prototype builds and design verification evidence
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Course Outline:

Day 1: Reliability Targets, Mission Profiles and Allocation

- Design for Reliability Process Across Concept, Prototype and Pilot Builds
- Mission Profile Definition for Temperature, Humidity, Vibration and Duty Cycles
- Reliability Target Setting From Warranty Period and Return Allowance
- Reliability Block Diagrams for Series, Parallel and Redundant Architectures
- Target Allocation to Subsystems Using Complexity and Criticality Weights

Day 2: Design FMEA, Prediction Handbooks and Physics of Failure

- Design FMEA to IEC 60812 as a Reliability Test Input
- MIL-HDBK-217 and Telcordia SR-332 Parts Count Comparison of Alternatives
- IEC 61709 Reference Conditions and Component Stress Derating Rules
- Physics of Failure Mechanisms in Solder, Polymers and Connectors
- Stress-Strength Interference and Monte Carlo Variation Modelling

Day 3: Accelerated Life Test Design and HALT Execution

- Arrhenius and Eyring Models for Thermal and Humidity Acceleration
- Inverse Power Law and Coffin-Manson Models for Voltage and Cycling
- Constant-Stress Versus Step-Stress ALT Plan With Stress Level Selection
- HALT Cold, Hot, Rapid Transition and Random Vibration Steps
- HASS Screen Profile and Proof-of-Screen From HALT Limits

Day 4: Life Data Analysis, Demonstration Tests and Reliability Growth

- Weibull and Lognormal Fitting With Suspensions by MLE and Regression
- Weibull Shape Interpretation for Early-Life, Random and Wear-Out Failures
- Zero-Failure Success-Run Demonstration Test Sample Size and Confidence
- Duane and Crow-AMSAA Growth Tracking Under IEC 61164
- Warranty Return Forecasting With Nevada Charts and Field Data

Day 5: Modelling Build: Product Reliability Plan and ALT Plan

- Case Product Brief for a Motor Controller Assembly
 - Case Allocation Model and Derating Review of the Controller Board
 - Case Acceleration Factor Calculation and Test Duration Estimate
 - Case Weibull Analysis of Seeded Test Results With Suspensions
 - Product Reliability Plan and Accelerated Life Test Plan Completion
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Skills You Will Gain:

- Mission Profile Definition
- Reliability Target Allocation
- Component Stress Derating
- Acceleration Factor Modelling
- Step-Stress Test Design
- Life Distribution Fitting
- Demonstration Test Sizing
- Warranty Return Forecasting

Why Attend This Course:

- Deliver a Product Reliability Plan and an Accelerated Life Test Plan for a case product to the engineering manager and the design review board
- Decide whether a prototype design meets its life target or needs a redesign, using acceleration factors and Weibull results rather than pass-fail counts
- Avoid late redesigns, field recalls and warranty costs caused by weak components found only after market release
- Pass on allocation templates, acceleration factor calculators and HALT test records to design, test and supplier colleagues

Conclusion:

Back at work, the participant hands the Product Reliability Plan to the engineering manager and the design review board, who use its allocated targets, derating findings and test evidence to decide whether a new product can move from prototype to pilot build. The Accelerated Life Test Plan goes to the test laboratory and supplier engineers, who schedule stress levels, sample sizes and HALT steps from it. After the first test cycle, the unit should compare observed failure mechanisms and Weibull parameters with the plan and update targets and acceleration assumptions.

Frequently Asked Questions FAQ:

What should participants know before a design for reliability and accelerated life testing course?

Participants should already contribute to product design reviews, qualification testing or quality analysis, and be comfortable with basic statistics and spreadsheets. Prior Weibull experience is not required. Bringing an anonymised product specification or test report helps them apply the modelling build to their own designs.

How does design for reliability and accelerated life testing differ from a maintenance reliability course?

Design for reliability and accelerated life testing acts on a product before release: targets, derating, stress tests and demonstration. Maintenance reliability courses act on installed plant equipment, choosing inspection and replacement tasks from operating failure histories rather than designing and testing new products.

Why is HALT used alongside accelerated life testing in design for reliability?

HALT finds design weaknesses fast by stepping stresses to operating and destruct limits, while accelerated life testing quantifies life at use conditions through acceleration models. HALT does not demonstrate field reliability, so the two are planned together: HALT to improve margins, accelerated life tests to estimate life.

What do participants take back from the design for reliability and accelerated life testing course?

Participants take back a Product Reliability Plan and an Accelerated Life Test Plan for a case product, with an allocation model, derating checklist, acceleration factor calculator, Weibull analysis worksheet and demonstration test sizing table they can apply to new products in their own unit.
