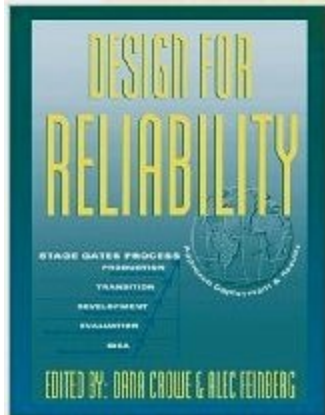


Design for Reliability & Quality Class ***From DfRSoft...***

Includes **DfRSoft Reliability & Quality Software to Provide Tools for Success**



This course is available in person to companies, on-line videos, or live Webinars. It includes class slides and instructional software. For the in-house course, we teach at your site or on line. All instructional methods also provide free consulting to ensure that you understand the class material. We guarantee this course is by far **Best in Class**. This course comes with free consulting anytime on course material.

(book available at CRCPress & Amazon.com)

Overview

This is an intense two day class with special topics included tailored to class interest. The course organization is compact and designed to be able to move at a rapid pace. It includes course material and reliability software that makes learning fast. People are busy so the class is compacted to save downtime and get engineers and managers back in the office to use the tools that they have learned with learning maximized. However, this is not a birds-eye view; the material provides depth and exposure to the industry's reliability and quality science.

We start by providing full explanation of how to grow reliability in a commercial environment and translate that into ROI dollars. Reliability growth starts in the design phase using tools like FMEA, reliability predictions, and reverse engineering. We move into the testing phase with describing how to demonstrate reliability with statistically significant tests. We also detail how to perform reliability growth tests such as HALT. A full or partial overview on HALT is available depending on class interest. Reliability statistical test and analysis

PART 1: BASIC METHODS IN RELIABILITY & QUALITY

1. Reliability & Quality in Today's Marketplace (36 slides)

- A Practical Approach to Reliability Implementation
- Reliability Growth and ROI
- Reliability as a Differentiator
- The Main Components of a DfRQ Company Program

2. The Stage Gate Approach (41 slides)

- Idea, Evaluate, Development, Transition, Production
- Understanding Each Gate - The Tools for your Program
- Piecing it Together - A Value Added Reliability Program

3. Basic Reliability Mathematics (4 Exercises, 36 Slides, 1 Homework)

(Using DfRSoft Tools)

- MTBF/Failure Rate Basics
- Failure Rate Conversion (FITs, FMH, MTBF, PPM, AFR, %Failure)
- System Reliability Analysis & Block Diagrams (Series, Parallel, Redundancy for K of N, Active/Standbys)
- Allocation (equal apportionment and by complexity)
- Reliability Predictions (Parts Count, Detailed Stress, Telcordia, Mil Std 217...)

4. Basic Quality Test Engineering (3 Ex., 70 Slides, 1 Homework)

(Using DfRSoft Tools)

- Cpk, Yield, Normal/Lognormal, & Six Sigma Analysis
- SPC Charts
- Lot Sampling (Hypergeometric, Binomial, Risks, OC) & double sampling.
- Visual Inspection/Design Release

PART 2: DEMONSTRATING & ANALYZING RELIABILITY

IDEA – STAGE GATE:

5. Top Down FMEA for Reliability Program Planning

(2 Exercises, 33 Slides, 1 Homework)

is key and is accessible to the student through our professional DfRSoft software tool. Each student has the software to follow along during the course to help problem solve quickly. This jump-starts one's capability. Accelerated test methods such as shock and vibration and how to analyze your test using DfRSoft's software, for both physics and statistics problems, are demonstrated for all accelerated testing, with clear exercises. The concept of test design by failure modes is presented. Examples are given. All the key accelerated test models (Arrhenius, Humidity, Thermal Cycle, Electromigration) are provided and illustrated. Both simple and advanced reliability math is overviewed, taught efficiently with software examples. The concept of design maturity testing using accelerated test methods and Chi-squared test planning and analysis, again with software exercises, are used to assess products failure rate/MTTF. We also detail system reliability analysis including block diagrams, and the different types of redundancy. We include Quality tools such as Cpk, lot sampling, sparing, availability, and normality analysis. Overview methods to analyze field return data to derive an MTBF. As part of reliability analysis a full session is given on Physics of Failure, what equipment to use and when (SEM, Auger, X-RAY, XRF, Focused Ion Beam, etc.) Numerous failure analysis pictures are shown to see first-hand the challenging failure modes and how their mechanisms are identified using such equipment. Key issues on RoHS are overviewed and depending on class interest are detailed. Other special topics include: Shock and Vibration, Advanced ESD concepts and Parametric Reliability Analysis. The course is concluded with how to ensure ROI and quantify reliability growth for management and its cost savings.

- What is a Top Down FMEA
- Top Down FMEA for Program Planning
- Team Approach
- Design Controls & Recommended Actions
- How to Make a Program Plan with Top Down Example
- Value of Derating (Derating Specs - DfRSoft Guideline)

5a Bottoms Up Design FMEA

- FMEA Terms
- DFMEA (streamline with an environmental approach)
- Keys to a good FMEA (without wasting everyone's time)

EVALUATION – STAGE GATE

6. Design Assessment Reliability Testing & Reliability

Growth (DART - HALT) (3 Exercises, 38 Slides, 6 Homework Optional Problems) **(DfRSoft Tools)**

- Finding Failure Modes – Test to Fail Not to Pass
- Accelerated Reliability Growth
- Multi-Test Reliability Growth Assessment Methods (new Chi-Squared Reliability Growth analysis method)
- Test Design by Failure Modes
- HALT
- Design Margin – Load-Stress Reliability Interference Assessment
 - Safety Factors & Derating (mechanical & electrical stress assurance)

DEVELOP - STAGE GATE

7. Advanced Reliability Mathematics

(Using DfRSoft Tools) (3 Exercises, 48 Slides, 5 Homeworks)

- Time Dependent Failure Rate
- Main Distribution of the Bathtub Curve, Weibull, Exponential, and Lognormal
- Key Reliability Functions (CDF, PDF, Hazard Rate)
- Reliability Plotting (life data analysis, censored data)

8. Accelerated Life Models & Environmental Profiling

(8 Exercises, 30 Slides, 3 Homework Problems)

- Acceleration Factors & Models (Temperature-Arrhenius, Peck Temperature-Humidity, Coffin-Manson Temperature Cycle, Modified Frequency Temperature Cycle, Vibration Accelerated Models, General Power Law Model)
- Chi-squared confidence method for accelerated testing
- Environmental Profiling (model for environments with varying stress profiles)
- Statistical Qualification Planning

9. Design Maturity Chi-Squared Demonstration Testing

(28 Slides, 4 Example Problems, 2 Homework Problems)

(Using DfRSoft Tools)

- Testing for a Reliability Failure Rate Objective?
- Accelerated Test Plan Examples
- Statistical Confidence Test Plans

Advantage: This Class is offered by DfRSoft and includes software making it the only complete course taught with the full suite of DfR software tools. It is also tailored for your needs.

DfRSoft's Advantages

- You will find this Class to contain far more cost effective practical information than any DfRQ course currently available. The course targets practical needs for industry (not academia). The ROI is higher as well. You get much more for your investment than other similar reliability courses.
- DfR Software Tool (Based in Excel) As the only DfRQ course taught with complete software, your understanding of reliability and quality will far exceed that of any other course. Although the software is optional, you will receive a trial copy during the class to help learn. So even if you do not purchase the software, you will be able to learn with it during the class. You will find no other software that provides full DfR capability. www.dfrsoft.com

Other Advantages

- Tailored to your company's needs in two ways. First we enquire what you consider the most valuable information to learn about. Then at the start of the class we ask students again what they want to get out of the course. In this way, we are able to focus on the best material necessary for your needs.

RELIABILITY MONITORING & SCREENING STAGE GATES

10. Reliability Monitoring and Screening

- Screening vs. Monitoring
- Common Screens and Monitoring Tests
- HASS Screening

11. Field Returns and Device Hours (3 Exercises, 31 Slides, 4 Homework Problems)

(DfRSoft Tools)

- Device Hours – Multiple Test Uses and Field Returns
- AFR – Most common company metric
- Field Return– Raw Data Analysis
- Field Return– Weibull Analysis,
- Mixed Modes Analysis (field returns, two populations)

12. Availability & Sparing (DfRSoft Tools) (1 Exercise, 6 Slides)

PART 3 SPECIAL TOPICS TAYLORED TO THE CLASS' NEEDS

13. Advanced CDM ESD Concepts

(29 Slides, Numerous Examples, 2 Homework Problems)

- Introduction CDM compared to HBM
- Why Ionizers can be important
- ESD versus EOS damage
- CDM Case Studies
- Advanced Audits/Investigation, Test Fixtures

14. Shock & Vibration (Numerous Exercises, 41 Slides, 4 Homework Problems)

- Understanding Gs & gs
- Drop Shock and Specifications
- Sine Vibration & Analysis
- Random Vibration and PSD Analysis
- HALT - ED Shaker: how they differ and advantages of each

15. Parametric Reliability

(18 Slides, Numerous Exercises, 3 Homework Problems)

- Drift Concepts, drift of a normal distribution
- Three methods to do Parametric Reliability analysis
- Advantages of parametric reliability
- Aging Laws

16. Physics of Failure 7 Step Problem Solving (15 Slides)

17. Physics of Failure Analysis Tools (29 Slides) -Detail

Analysis Pictures Showing Strengths of Instruments

- SEM (FE-SEM, EDS)
- Digital Microscopy
- Focused Ion Beam
- Real Time Radiology, X-Ray Maps
- C-SAM
- Thermal Imaging

- FTIR
- Scanning Auger
- Atomic Force Microscopy
- SIMS
- Other Tools Including ESD Simulator
- Sample Preparations

18. Physics of Failure (136 Slides, Numerous FA Pictures, Industry Lessons Learned and Design Rules to Avoid Issues)

- Four main types of aging
- Diffusion - Substitutional, Kirkendall
- Intermetallics - Au Embrittlement, Purple Plague
- Bond wire failures - non stick, intermetallic
- Eight Types of Corrosion - Area effect, and Prevention
- Dendritic Growth, Ag Migration & Electromigration
- Modes of Mechanical Failure
- Fatigue Failure
- Wear
- Stress-Strain – Yielding, Vibration,
- CTE's Mismatch, Thermal Fatigue
- Engelmaier IPC Solder Joint Life Model, BGAs
- Electronic Failure modes from shock, vibration
- Creep, Solder Creep, Creep Resistance in Plastics
- Organic contamination
- Popcorn Cracking, Voiding Delamination
- Assembly Errors
- Solder Failures (non wetting, grain size, leaching, coverage)
- Contamination – Solder non-wetting, Epoxy non-stick
- Plating Contamination
- RoHS Lead Free Solder Issues
- Cu Dissolution
- BGA, Tin Whiskers
- PCB Finishes
- ESD & EOS - Dielectric Breakdown
- Current Density & Fusing of Bond wires and wires
- Junction Temperature Issues & Modeling

19. Putting it all Together (19 Slides)

20. Homework Solution Set (25 Slides)

Total Slides: 761 Slides Total (Rate of presentation is about 50 slides per hour, total 15 hours)

Enrollment On-Site

Send purchase order to:
 DfRSoft
 9510 Centerwood Dr.
 Raleigh, NC 27617

Email: support@dfrosoft.com

Payment Method by purchase order, paypal or credit card)

For further information, please call Dr. Alec Feinberg at 617-943-9034.

On-Site Company Cost Information (same price as on line for >5 people call or email)

- Two and half day DfRQ course - \$950 Per Person (Min. 4 people or \$3800 payment)
- Note 5 or more people, \$850
- No Extra Cost (i.e. DfRSoft pays for its travel expenses)
- Optional - Design for Reliability & Quality Software \$395 (Free Trial copy included for class)

On-Line Information (Call or email for video course, Webinar registration now open)

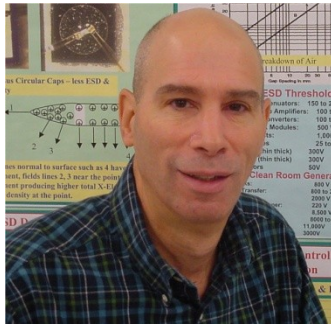
- \$850 Per Person Video (Purchase on line at DfRSoft.com using our “Buy Now” button near the bottom of the webpage and receive a password and instructions on the same day)
- Free unlimited consulting anytime on the course material
- Optional - Design for Reliability Software \$395 (Free Trial copy included)
- Call (617) 943-9034 for further details

Software overview at www.DfRSoft.com, a trial free copy is always included independent of class size. Special offers are available at www.DfRSoft.com for companies.

Each Student Receives:

- Class Material
- CD with DfR Trial Software based in excel, DfRQ Industry Specifications, DfRQ Publications
- Class Diploma

Instructor Information



Dr. Feinberg has a Ph.D. in Physics, is the founder of **DfRSoft**, and is the author of the books, *Design for Reliability* and *Thermodynamic Degradation Science - Physics of Failure, Accelerated Testing, Fatigue and Reliability Applications*. Alec has provided reliability engineering services for over 35 years in all areas of reliability and on numerous products in diverse industries that include solar, thin film power electronics, defense, microelectronics, aerospace, wireless electronics, and automotive electrical systems. He has provided training classes in Design for Reliability, Shock and Vibration, HALT, Reliability Growth, Electrostatic Discharge, DFMEA, and Physics of Failure. Alec has presented numerous technical papers and won the 2003 RAMS Alan O. Plait best tutorial award for the topic, Thermodynamic Reliability Engineering.