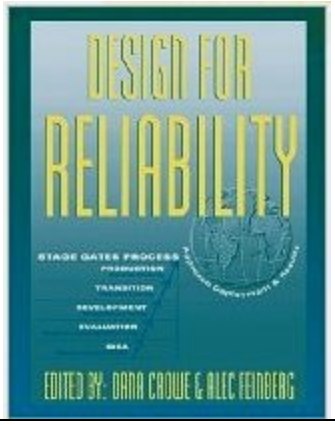
Practical Reliability for Industry From DfRSoft...

Tools for Success



This course is available in person to companies, on-line videos, or live Webinars. It includes class slides, numerous examples, exercises and optional homework. 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 practical course for industry focusing on applying reliability in real world situations. It uses a stage gate approach to reliability as product transition from the Idea Phase, Evaluate, Develop, Transition and lastly to the Production Stage. This is a two-day webinar (broken down into 4 half days) which includes course material and optional reliability software (30-day trial) to accelerate learning. The material provides depth and exposure to the industry's reliability science.

We start with basic methods in reliability & quality, providing full explanation of how to grow reliability in a commercial environment and translate that into ROI dollars. Reliability growth starts in the Design Idea phase using tools like FMEA, reliability predictions, and reverse engineering. Here we provide a formal method for providing a detailed reliability plan for the product. We describe how to develop the plan with management and engineers so that everyone is involved and sample sizes and cost are obtained up front. We move into Evaluation stage gate demonstrating and analyzing reliability in the testing phase with prototypes. We describe how to organize an effective DART (design assessment reliability testing) plan that includes HALT. We detail the method of test design by failure modes. As the product

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)
- **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**
- **Reliability Predictions (Parts Count, Detailed Stress, Telcordia, Mil Std 217…)**

4.Basic Quality Test Engineering (3 Ex., 70 Slides, 1 homework)
- **Cpk, Yield, Normal/Lognormal, & Six Sigma Analysis**
- **SPC Charts**
- **Lot 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)
- **What is a Top Down FMEA**

matures and the design becomes frozen, we move into the Development stage gate where we often do Design Maturity Testing demonstrating reliability with qualification testing. We go over the common specification and describe how to design test with and without specifications. Reliability statistical analysis is key and is accessible to the student by explaining how to use software to solve problems. DfRSoft software is the optional teaching tool but other tools are described and it is not required for students to have. We move into the Transition stage gate. Here we are concerned with production screening such as HASS. Finally we move into production monitoring where we monitor reliability with a sampling strategy.

Test methods such as temperature, temperature cycle, humidity, shock and vibration and how to analyze your test using this 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 and taught efficiently with examples. The concept of design maturity testing using accelerated test methods and Chi-squared test planning and analysis, again with exercises, are used to assess products failure rate/MTTF. We include Quality tools such as Cpk, lot sampling, sparing, availability and normality analysis. We also describe methods to analyze field return data to derive an MTBF. As part of reliability analysis, we present special topics tailored to the classes needs. This includes 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. Other topics include a strong overview in understanding

- **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

- **Key to a Good DFMEA**
- **Most Efficient DFMEA**

EVALUATION – STAGE GATE

6 .Design Assessment Reliability Testing & Reliability Growth (DART - HALT) (3 Ex, 38 Slides, 6 Homework Prob.)

- **Finding Failure Modes – Test to Fail Not to Pass**
- **Accelerated Reliability Growth**
- **Test Design by Failure Modes**
- **HALT**
- **Design Margin – Load-Stress Reliability Interference Assessment**
- **Electrical Derating**

DEVELOP - STAGE GATE

7. Advanced Reliability Mathematics
(3 Ex., 30 Slides, 3 Homework Prob.)

- **Time Dependent Failure Rate**
- **Main Distribution - 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 prob.)

- **Acceleration Factors & Models (Temperature-Arrhenius, Coffin-Manson Temperature Cycle, Vibration Accelerated Models…)**
- **Chi-squared confidence method for accelerated testing**
- **Environmental Profiling (model for environments with varying stress profiles)**

9. Design Maturity Chi-Squared Demonstration Testing
(8 Exercises, 30 Slides, 3 Homework prob.)

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

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 Prob.)

in Shock and Vibration, Advanced ESD methods, RoHS challenges, and parametric reliability analysis.

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

- **Device Hours – Multiple Test Uses and Field Returns**
- **AFR – Most common company metric**
- **Field Return– Raw Data Analysis**
- **Field Return– Mixed Modes and Weibull options)**

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

PART 3 SPECIAL TOPICS TAILORED TO THE CLASS' NEEDS

13.Advanced CDM ESD Concepts
- 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)
- Understanding Gs & gs
- Vibration testing for Shipping
- Optional additional material

15. Physics of Failure 7 Step Problem Solving
16. Physics of Failure Analysis Tools Detail Analysis Pictures Showing Strengths of Instruments
- SEM (FE-SEM, EDS)
- Digital Microscopy
- Real Time Radiology, X-Ray Maps
- Thermal Imaging
- FTIR

17. Physics of Failure (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
- ○ Dendritic Growth, Ag Migration & Electromigration
- 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
- ESD & EOS - Dielectric Breakdown
- Current Density & Fusing of Bond wires and wires
- Junction Temperature Issues & Modeling

your needs.	**18. Parametric Reliability (Optional)** **19. Putting it all Together** **20. Homework Solution Set**

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@dfrsoft.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 - $925 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 included for class)

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

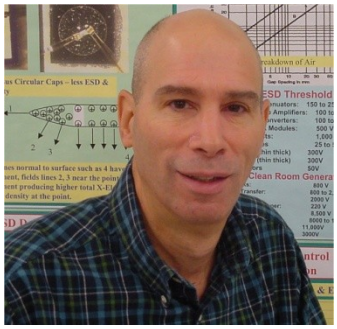
- $850 Per Person Video (Purchase on line at DfRSoft.com using our "Buy Now" button near the bottom of the webpage and receive a password and instructions on the same day)
- Free unlimited consulting anytime on the course material
- Optional - Design for Reliability Software $395 (Free Trial copy included)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

Optional Software overview at www.DfRSoft.com, a trial free copy is included. Special offers are available at www.DfRSoft.com for companies.

Each Student Receives:

- Class Material
- Optional DfRSoftware 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.