DfRSoft Course Overview

Cutting Edge Useful Physics of Failure Reliability Methods and Tools (4 hours, $400)

Course Overview

This course will provide very useful cutting edge physics of failure reliability methods for a number of important helpful areas to:

- Generate an SN Curve using established rules (including notches, grain size, etc.) for material when the SN curves are not available in the literature,
- Assessing how much work and life is available in your product using an ultimate work test method,
- Perform environmental profiling to determine ones equivalent use stress when products have multiple field use stress conditions so accelerated testing can be designed between stress and use conditions,
- Perform solder joint (BGA) thermal cycle life modeling with and without underfill using the Engelmaier model (without testing)
- Use the Weibul beta to obtain physics of failure power aging laws
- Understanding why a lognormal failure rate statistic can be relevant for certain physics of failure occurrences and how it can lead to accelerated cheaper testing
- Obtain a physics of failure (accelerated test) aging law - wear and creep provided as examples,
- Use noise analysis (not just in the acoustic sense) to determining impending failure in subtle aging situations when gross degradation parameters are not sensitive enough,
- Use multiple regression (for many variables) in excel for problems like DOE, thereby making more accurate predictions

Detailed Descriptions

High stress ultimate work methods for determining product useful life
This method involves highly accelerated stress methods to find the product ultimate work in a very short laboratory time frame which equates to its free energy for the application of concern and can be used to determine the life of a product including metals, batteries, metal creep, wear etc. Once the ultimate work is determined, the product useful work and life can be accessed for any work situation with knowledge of the work equation found using physics of failure metods. Knowledge of the free energy is also useful for SN type curves generation.
SN Curve generation using established rules for different materials. Often one can generate an SN curve with certain rules when SN curves are not available for the type of metal system one is concerned with. This typically involves knowledge of the materials ultimate strength.

Environmental profiling: How do you design an accelerated stress test when the field use stress has multiple stresses exposed over its life? This new methods uses standard accelerated testing equations to

cumulate field use stresses and collapse it into one equivalent stress so that use and accelerated stress values can be used to design the test properly.

Engelmaier Solder Joint Modeling with & without underfil: Determine the cycles to failure for a BGA of interest with and without underfil using the Engelmaier model. The Engelmaier model will predict the BGA life without any testing. Thus, one can determine if a part is suspect or not and decide on if underfill is required or a new design is needed or even to test the part to fully access the cycle life.

Understanding the Weibull Beta for Phsyics of Failure aging Laws. In reverse, physics of failure aging laws influence reliability distributions. Therefore, the Weibull Beta actually provides you with a physics of failure aging power law information. This is useful both in determining the life of the product and for accelerated testing. That is from the Weibull beta we can usually determine the accelerated test equation.

Lognormal distribution and physics of failure: Typically one usually uses a distribution that best fits the data. One might ask, is there a physics of failure reason for the lognormal distribution? We will find that this knowledge produces better ways to look at factory and life test data and the ability to reduce reliability sample sizes and test times.

Multiple Linear Regressions in Excel to help in modeling and DOE assessment. It is always desirable to have an equation that models complex data like DOEs to be more accurate in predicting trends.

Monte Carlo methods to assess complex stack ups such as multiple spring responses. The Monte Carlo method makes complex stack ups look very manageable.

Modeling strategies for determining physics of failure (accelerated test) aging law: In this method, we provide basic strategies to determine physics of failure equations. Here we provide a number of examples on how to provide good modeling using examples such as Wear and Creep.

Noise analysis: Noise increases as aging occurs in systems (not just in the acoustic sense but we can find noise in electrical currents, voltages, blood flow etc. We first explain what noise is, why it is so sensitive, and how to assess it, to determine impending failure for even complex systems when subtle methods are likely the only option.