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Accelerated Test Data Analysis 4 day Seminar

Presented by the Leader in Accelerated Testing and Reliability Data Analysis

Instructor: Mr. Wayne Nelson, Ph.D.

APPLICATIONS OF ACCELERATED TESTING

Products last for years under normal operating conditions. However, product tests must quickly yield reliable information for management and engineering decisions. Accelerated testing quickly yields such information. Test specimens are subjected to higher than normal levels of temperature, voltage, humidity and vibration and fail much sooner. Then a mathematical model based on physical considerations is fitted to the early failure data, yielding estimates of product reliability under normal conditions, including the failure rate, percentage failing on warranty, and mean time to failure. This course will show how accelerated testing can be used to measure and improve the reliability of diverse products including:

- Electronics which include microprocessors, semiconductors, solid-state devices, conductors, encapsulants, connections, and capacitors;
- Metals undergoing fatigue, creep, rupture, and corrosion;
- Electrical insulations and dielectrics in cables, motors, capacitors, and transformers;
- Ceramics, plastics, composites, and other materials; and pharmaceuticals, food, paints and protective coatings, rubber and elastic materials, and chemicals.

WHO SHOULD ATTEND

This course on engineering and statistical models and data analysis methods will benefit engineers, statisticians, and others working in development, reliability, testing, manufacturing, procurement, and data analysis. You will learn how to use engineering and statistical models for accelerated tests, how to plan efficient tests, and how to estimate and improve product reliability.

BENEFITS

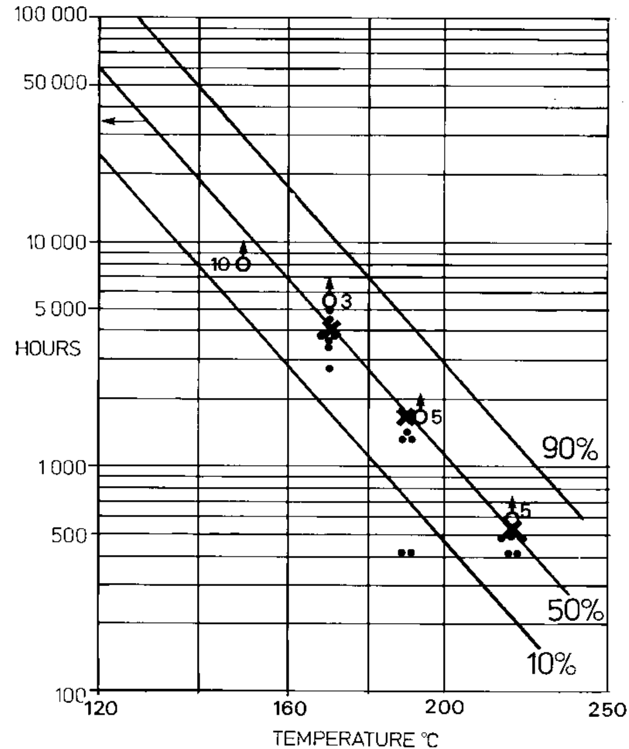
You will learn how to use up-to-date methods to successfully:

- Determine test purposes.
- Accelerate tests through overstress, high usage rate, termination of the test before all specimens fail, specimen design, degradation, cycling, etc.
- Plan efficient tests that yield the most accurate product information for the allotted test time, cost, and constraints.
- Model and understand how product life or degradation depends on accelerating stresses and on design, manufacturing, materials, and operating variables, thereby learning how to improve product reliability. Analyze test data with simple and informative plots to estimate reliability and to assess the data and assumed model.
- Analyze data with different failure modes to estimate reliability at a design condition when all failure modes act or when some modes can be eliminated through better design or manufacture.

o Compare designs, manufacturing methods, vendors, materials, etc., with respect to their effect on product reliability.

o Analyze data with computer programs that provide reliability estimates with confidence limits indicating how accurate estimates are.

You will see a variety of applications to electronic, mechanical, and other products that will illustrate the methods. You will apply the methods to actual problems, including your own data, which you are encouraged to bring.



COURSE OUTLINE

DAY 1:

o 8:30-12:00, 1:00-3:00 Survey: applications, types of data, types of accelerated tests and stress loading, practical engineering considerations, and common tests (overstress, ESS, burn-in, single condition, elephant).

3:00-5:00 Accelerated Testing Models: statistical life distributions (exponential, Weibull, lognormal, and others) and physical accelerated life-stress relationships (Arrhenius, inverse power, Eyring, etc,) including multivariable models for the effect of design, materials, manufacturing, operating, and other variables.

DAY 2:

o 8:30-12:00 Models: (continued)

o 1:00-5:00 Graphical Data Analysis: simple probability plots (Weibull, lognormal, etc.) and relationship plots (Arrhenius, inverse power, etc.) that yield estimates of product life and assessments of the data and assumed model (distribution and relationship).

DAY 3:

o 8:30-12:00 Computer Data Analysis: maximum likelihood fitting of models to (censored) data with runouts to obtain

estimates and confidence limits for product reliability and model parameters, and to assess the data and model.

o 1:00-5:00 Test Plans: how to choose test conditions and the number of specimens at each, including optimum, traditional, and good compromise plans.

DAY 4:

o 8:30-11:00 Competing Modes: series-system model for products with a number of failure modes, graphical and computer analysis of such data, and the effect of specimen and product size.

o 11:00-12:00, 1:00-3:00 Step and Varying Stress: models and data analysis for tests with step and varying stress.

o 3:00-5:00 Degradation: models and data analysis for accelerated tests where product performance degrades with age.

TEXT AND COURSE MATERIALS

Accelerated Testing: Statistical Models, Test Plans, and Data Analyses by Wayne Nelson, published by Wiley (2004). In his review of this book in *Technometrics* (May 1991), Prof. William Meeker says, "This book will be an essential reference for engineers, physicists, chemists, statisticians, or others who are doing or who are thinking of doing accelerated testing. It would be an outstanding textbook for an advanced course in applied life data analysis." **This textbook will be required for this course for each attendee. This can be purchased at Wiley Publishing, mention that you are using this textbook as a classroom course and you should receive a 43% discount off of list. Please order these at least three weeks in advance.**

Plotting papers, computer program information, and other reference materials are furnished. This will be provided as a pdf file and should be printed prior to the course.

INSTRUCTOR: Dr. Wayne Nelson is a leading expert on analysis of reliability and accelerated test data. He consults on applications and gives training courses for companies and professional societies. For 24 years he consulted across the General Electric Co. and received the Dushman Award of GE Corp. R&D for developments and applications of product reliability data analysis. He was elected a Fellow of the Amer. Statistical Assoc. (1973), the Amer. Soc. for Quality (1983), the Institute of Electrical and Electronics Engineers (1988) for his innovative developments. He was awarded the 2003 Shewhart Medal and the 2010 Shainin Medal of ASQ and the 2005 Lifetime Achievement Award of the IEEE Reliability Society for outstanding developments of reliability methodology and contributions to reliability education. He authored three highly regarded books *Applied Life Data Analysis* (Wiley 1982, 2004), *Accelerated Testing* (Wiley 1990, 2004), *Recurrent Events Data Analysis for Product Repairs, Disease Recurrences, and Other Applications,* (SIAM 2003), two ASQ booklets, and 130 journal articles. He can be contacted via WNconsult@aol.com