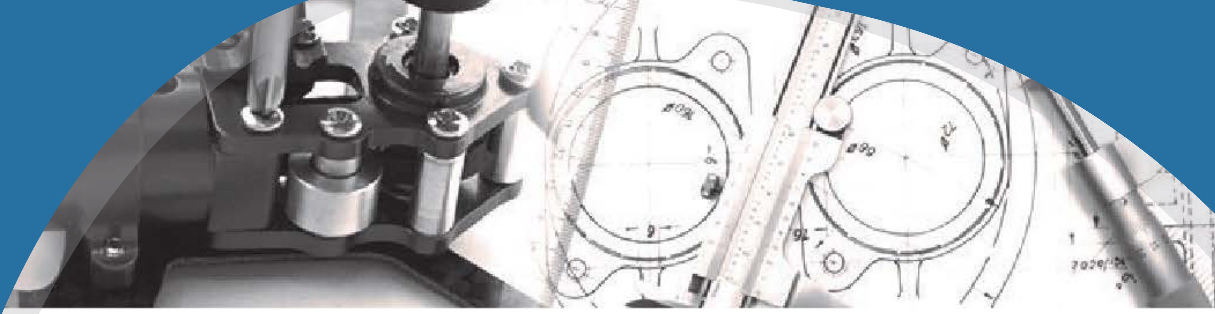


HOBBS ENGINEERING

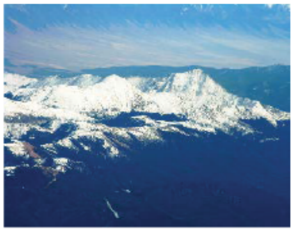
Advancing Reliability in Engineering for over 37 Years!

Seminars **Webinars** **Consulting**

Seminars in Accelerated Reliability Technology

- HALT & HASS + Workshop
- Mastering HALT & HASS
- HALT & HASS + Demonstrating Reliability
- Demonstrating Reliability
- Accelerated Test Data Analysis
- Cooling Techniques for Electronic Equipment
- Design for Reliability & Quality
- Design and Analysis of Experiments
- Lead-Free Solder Joint Reliability
- Physics of Failure
- Preventing Thermal Cycling & Vibration Failures in Electronic Equipment
- Shock & Vibration: Test, Design & Design Assurance

HOBBS ENGINEERING
A Division of Qualmark



Hobbs Engineering was established in 1978.

The Accelerated reliability methods of HALT & HASS that were invented by Dr. Gregg Hobbs have been proven by thousands of participants throughout the world.

Hobbs Engineering has brought together many of the world's foremost instructors in complementary disciplines.

All of these programs have one common goal: to produce better quality and reliability sooner and for less cost.

Webinars in Accelerated Reliability Technology

We offer a variety of webinars, many of which are recorded for you to view at your leisure. Our in-house webinars are popular as we can gear them to your specific needs and proprietary questions can be asked.

Reliability Consultants / Instructors

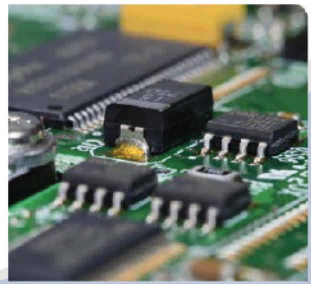
- Albertyn Barnard, MEng
- Joseph Bernstein, Ph.D.
- Steven Carlson, MSME
- Jean-Paul Clech, Ph.D.
- Abhijit Dasgupta, Ph.D.
- Alec Feinberg, Ph.D.
- Aldo Fucinari, BSEE
- Chet Haibel, Master of Engineering
- Douglas Montgomery, Ph.D.
- Wayne Nelson, Ph.D.
- John Paschkewitz, BSME

See our website for an Introduction to the Instructors

For reservations or brochures on courses:

Call 303-655-3051

Hobbs Engineering Corporation
A Division of Qualmark
10390 East 48th Avenue
Denver, CO 80238 USA
E-Mail: learn@hobbsengr.com
Website: www.hobbsengr.com



HOBBS ENGINEERING
A Division of Qualmark

HALT & HASS + Workshop

Presented by Chet Haibel, Master of Engineering or Aldo Fucinari, BSEE - 2 days

This course begins with the science behind the HALT & HASS techniques. It provides the hard engineering and explains why the failures accelerated through higher stress levels are essential to developing reliable products.

The course offers step-by-step instruction on why, how, and when to perform HALT (environmental and other stress stimulation methods applied in the design phase), how to correctly set-up and tune HASS profiles on production units, and how to prove that the HASS profiles leave enough life left so the product scan be confidently sold to customers. Learn how to vastly improve design margins and eliminate process problems using these highly accelerated techniques. During the Workshop portion, the students participate in the running of the HALT tests.

These techniques were developed by Gregg K. Hobbs, Ph.D., P.E., who taught them worldwide for 28 years until his passing in 2010. His legacy lives on through the efforts of our instructors.

Mastering HALT & HASS

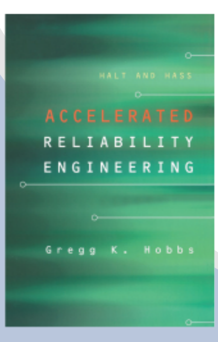
Presented by Chet Haibel, Master of Engineering or Aldo Fucinari, BSEE - 2 days

This is a similar course to the HALT & HASS + Workshop class, except that there is no Workshop. Instead there is more classroom information covered.

Demonstrating Reliability

Presented by Chet Haibel, Master of Engineering - 2 days

HALT deals wonderfully with design margin issues in electrical and mechanical devices and with overstress fatigue issues in mechanical devices. But what about cable flexing; connector insertion and extraction; switch cycling; belt, pulley, and gear wear; corrosion; evaporation; and many more endurance" issues? This class zooms in on the end-of-life (Wear-Out) failures that are caused by a (failure mechanism) "process" consuming some "reservoir" of material.



Starting with a review of the nature of failures and the mathematics that describe them, optimal test strategies are laid out to save you time and money. From pass / fail tests of single-shot devices, progressing through various methods of reducing test time, number of cycles, and/or the number of samples, this class culminates with how to use multiple accelerating stresses (that are not independent) with unknown stress-life relations to demonstrate reliability.

HALT & HASS + Demonstrating Reliability

Presented by Chet Haibel, Master of Engineering - 3 days

This seminar combines the two previously described seminars.

Accelerated Test Data Analysis

Presented by Wayne Nelson, Ph.D. - 4 days

Accelerated testing quickly yields information on the reliability of products by exposing them to higher than normal stresses and then fitting engineering models to the data to obtain estimates of product reliability under normal conditions. Such testing applies to electronics including microprocessors, semiconductors, solid state devices, conductors, encapsulants, connections and capacitors. It also applies to metals, insulation materials, ceramics, plastics, composites, pharmaceuticals, food, paints, rubber and chemicals.

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.

Cooling Techniques for Electronic Equipment

Presented by Steven Carlson , MSME - 2 Days

Find out if your present systems are adequately cooled, how to avoid many common cooling problems and how to design efficient, reliable cooling systems for many different types of electronic cabinets. The purpose of this course is to show designers and engineers quick methods for designing electronic equipment to withstand severe thermal environments without failing. Techniques are presented which will permit the evaluation and design of cost effective, compact cooling systems, without the aid of a large digital computer. Learn simple design rules and guidelines, which can improve the effective cooling of your sophisticated electronic components used in today's military, industrial and commercial electronic systems.

Learn methods for determining thermal stresses in lead wires and solder joints due to a mismatch in thermal expansions. This course is based upon the popular book *Cooling Techniques for Electronic Equipment by Prof. Dave Steinberg.*

HOBBS ENGINEERING
A Division of Qualmark

Design and Analysis of Experiments

Presented by Douglas Montgomery, Ph.D. - 3 days

This class covers the most effective approach for learning how to design, conduct, and analyze experiments that optimize performance in products and processes. He shows how to use statistically designed experiments to obtain information for characterization and optimization of systems, improve manufacturing processes, and design and develop new processes and products. You will also learn how to evaluate material alternatives in product design, improve the field performance, reliability, and manufacturing aspects of products, and conduct experiments effectively and efficiently. Placing a strong focus on the use of the computer, providing output from two software products: Minitab and Design Expert. The following will be covered:

- Timely, new examples as well as expanded coverage on adding runs to a fractional factorial to de-alias effects.
- Includes detailed discussions on how computers are currently used in the analysis and design of experiments.
- Offers new material on a number of important topics, including follow-up experimentation and split-plot design.
- Focuses sharply on factorial and fractional factorial design.

Lead-Free Solder Joint Reliability

Presented by Jean-Paul Clech, Ph.D. - 2 days

This seminar provides an extensive coverage of lead-free attachment reliability issues and trends and offers practical guidelines to assess the reliability of lead-free solder joints and circuit board assemblies. An in-depth understanding of the multitude of material, design and manufacturing parameters that affect solder joint reliability is critical to the deployment of lead-free circuit board assemblies. Following a review of the basics, the seminar puts in perspective a wide range of lead-free data, material properties, test and modeling results from across the industry. Accelerated test results are discussed for common components (leadless, leaded, BGA, Flip-Chip, CSPs), including the effect of board and component finish on lead-free reliability, and a comparison of tin-lead, mixed assemblies and lead-free reliability data.

Design for Reliability & Quality

Presented by Alec Feinberg, Ph.D. - 2 Days

This course describes design, analysis and demonstrating reliability and quality

- Approach to reliability program management
- Basic reliability mathematics (MTBF, MTTF, failure rate basics, AFR, Bathtub Curve)
- System block diagrams analysis (series and parallel redundancy (n of k, switching, etc.)
- Reliability predictions and allocation
- Advance reliability mathematics (main distributions, CDF, PDF, Rel., statistical confidence)
- Reliability plotting (Weibull, Lognormal, Exponential) and mixed modes
- Field returns analysis & Device hours importance
- DFMEA-Top Down, Elec. Derating, Safety Factors
- Accelerated multi-test & design (Accel. Factors, & models, confidence)
- Test design by failure modes
- Environmental profiling device use conditions
- HALT & HASS, Reliability growth basics, CARG
- Parametric Reliability
- Availability & Sparing
- Key Quality tools (SPC, Lot sampling, Cpk, yield, DOE, & Six sigma tools)
- Special topics: ESD, Physics of Failure, Shock & Vibration basics, Problems Solving

OPEN SEMINAR REGISTRATION AND RATE SCHEDULES:

(North America)

2 days - $1,195   **3 days** - $1,595   **4 days** - $1,895

Please inquire for rates in all other geographic areas.

1) Attending two consecutive 2-day seminars at an event is not considered to be a 4-day seminar.
2) The above rates include course notes and text books (if applicable).

HOBBS ENGINEERING
A Division of Qualmark

Physics of Failure

Presented by Abhijit Dasgupta, Ph.D. - 2 days

This course offers an introductory understanding of some of the key accelerated test techniques needed to develop reliable electronic products. Participants are presented with various physics of failure methods to provide design and test for reliability. Learn how products really fail and understand key reliability issues. Become acquainted with the failure modes and mechanisms associated with various electronic devices and assemblies. Determine the stresses associated with the assessment of reliable electronic equipment and examine techniques to address problems of reliability. Investigate the usage and applicability of reliability standards and handbooks. The content of this course is complementary to the HALT and HASS seminars.

Preventing Thermal & Vibration Failures in Electronic Equipment

Presented by Steven Carlson, MSME - 2 days

This seminar will focus on:

1) To understand how variations in coefficients of thermal expansion (CTE) can affect the magnitude of the displacements, forces, and stresses that are developed in electronic assemblies during thermal cycling environ-ments, and how these factors affect fatigue life.
2) To understand how resonant conditions can affect dy-namic displacements, forces and stresses in electronic assemblies during different sine and random vibration environments.
3) To understand the concept of "damage accumulation" and how it can be used to determine the approximate fatigue life of various electronic assemblies due to different combinations of fatigue accumulated in thermal cycling and vibration environments.

This course is based upon the popular book Preventing Thermal and Vibration Failures in Electronic Equipment by Dave Steinberg.

Shock & Vibration: Test, Design and Design Assurance

Presented by Alec Feinberg, Ph.D. - 2 days

This intense two-day course covers:

1) Basic terms G, Grms, G-Force etc.
2) Types of shock, shock test & design, shock equipment, understanding the electrodynamic shaker system
3) Sine vibration (basic math, transmissibility, Q factor, sweep rates, dwells, sine fatigue, S-N curves, accelerated sine testing
4) Random vibration, why random not sine, frequency & time domains, tri-axial test, accelerometers, transportation vibration, sine-on random, random-on-random, repetitive sock, HALT, accelerated random vibration testing, miles equation
5) Complex system level degradation, vibration noise analysis, parametric failure rate modeling
6) Material selection in design, elastic deformation, yielding, creep, cumulative creep, cyclic fatigue, S-N curves, PCB fatigue life, Steinberg method, Englemaier BGA model
7) Design margin, safety factors, safety margin, electrical derating
8) Stack-up, Monte Carlo analysis, WCSA
9) Isolation and damping, vibration isolation, shock isolation, packaging guides, vibration absorption
10) Reliability & quality tools, system reliability, block diagrams, K of N redundancy, allocation, advanced reliability mathematics, design maturity testing
11) Accelerated testing general models, environmental profiling, MTBF predictions, quality aids, Cpk yield, normality, environmental stresses
12) Physics of failure—creep, fatique, wear, diffusion, intermetallics, corrosion, Ag migration, CTE mismatch, intermetallics, RoHS

For reservations or brochures on courses:

Call 303-655-3051

Hobbs Engineering Corporation
A Division of Qualmark
10390 East 48th Avenue
Denver, CO 80238 USA

E-Mail: learn@hobbsengr.com
Website: www.hobbsengr.com