Accelerated Testing: ESS, HALT and HASS

Course No. 240

FOR WHOM INTENDED: This course is for individuals such as quality and reliability specialists who specify screens and interpret results, project managers wishing to reduce life cycle costs, production and inspection managers whose people screen and interpret results, environmental test specialists who help develop optimum screens, and design engineers who use stress testing for product development and design verification.

BRIEF COURSE DESCRIPTION This course shows why Environmental Stress Screening (ESS) and its modern descendents, HALT (Highly Accelerated Life Testing) and HASS (Highly Accelerated Stress Screening) are important steps in the development, design and manufacture of both commercial and military systems that require high-reliability performance. It demonstrates the purpose of screening, which is to precipitate and make visible any existing latent flaws. Well-screened systems have greatly improved mean time between failure (MTBF) rates, their life cycle costs are lower, their reliability is higher. Environmental Stress Testing and HALT have long been useful tools in the development and design of new products.

This course addresses thermal and vibration environments and test facilities, how to prepare before performing HALT, and how to run HALT tests. Single-environment tests are discussed, and then combined environments. Fixturing, HALT profile writing, failure types and analysis and data analysis topics are considered. The HASS section of the course shows how to develop an effective screening process. The course concludes with a discussion of HALT and HASS specifications.

The course is presented as a series of highly-interactive lecture/discussion sessions. Problems for individual and group solution are interspersed throughout the course to act as training aids and to evaluate class progress. There will be a class exercise in writing a HALT profile—class members will give suggestions while five common profiles are written in a user friendly interface.

Special-interest discussions are encouraged outside of the regular course sessions.

PREREQUISITES TTi recommends that this course be taken after Course No. 116, Fundamentals of Vibration For Test Applications and either Course 230, Climatic Test Techniques or Course 425, Environmental Testing Procedures.

CERTIFICATE PROGRAMS This course may be used as an elective for any TTI specialist certificate program.

TEXT Each student will receive a course workbook including most of the viewgraphs used in the presentation.

NOT AFFILIATED WITH ANY VENDOR TTI sells no hardware or firmware. Equipment manufacturers' field sales people may lack time to teach fundamentals. TTI training helps you to negotiate for the equipment you really need.

COURSE HOURS, CERTIFICATE AND CEUs Open courses meet seven hours per day. Upcoming presentation dates can be found on our current open course schedule. Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

For schedules, general information and registration forms, see TTi's web site.

Course Outline

Introduction to Environmental Testing
- Test Objective • Environments • Tailoring • IPT • Documentation

Environmental Stress Screening (ESS)
- History • Myths • Flaw Populations • Failures vs. Cycles
- Quantitative Verification • Test Strength • ESS Process Plan
- How to Design an ESS Process • Process Control • Limits
- NAVMAT P-9492 • Sample ESS Profiles • ESS & Reliability • Rules

Environmental Forcing Functions: Vibration
- Best Forcing Functions? • Sample Requirements • Effects of Vibration • Shakers • Repetitive Shock vs. E-D Shaker
- Selecting Vibration Screen Development Method • Axes of Excitation • Screen Duration • ESS Methods: Tailored Response • Step Stress • Fault Replication • Heritage • % Useful Life
- Hidden Assumptions • Screening Configurations
- Screening Effectiveness • Level of Assembly

Environmental Forcing Functions: Thermal & others
- Constant Temperature • High Temperature Burn In, Electrical Stress • Power Cycling • Thermal Cycling
- S-N Curve • Typical Endurance Limits • Thermal Profile
- Commonly Used Temperature Ranges, Rates of Change
- Thermal Shock • Survey • Dwell Times • Combined Environments

HALT: Highly Accelerated Life Testing
- Test Time Compression • Assumptions • Different environments, different results • Types and Rates of Test Time Acceleration
- Effects of: Vibration • Thermal Cycling • Humidity • Power cycling
- Are accelerated tests always shorter? • "Life" Tests
- Fatigue life vs. service life • Cautions

Equipment for HALT
- Liquid nitrogen: Reasons for Using • Properties • Bulk Tanks Dewars • Piping • Offgassing • Prolonging liquid state • Safety
- Repetitive shock vs. Electrodynamic Vibration
- Repetitive Shock Equipment • How it Works • Safety
- Special Equipment for Humidity • Sensor attachment

Performing HALT
- When to Use HALT • How Many Samples? • Margins
- How to run the tests • The test series • Single environments
- Combining environments wisely • Sensor Placement • Fixturing
- Tests and Profiles: Cold Only • Heat Only • Cycling • Vibration • Combined Test • "Super HALT"
- Failure types • What to do on Failure • Samples
- HALT with not enough samples • Data analysis • Test reports

Highly Accelerated Stress Screening (HASS)
- Comparison with ESS • Writing a HASS Profile
- Two common types of profiles for HASS
- Ramp Rates and Dwell Times • Precipitation Screen
- Number of Cycles • Guidance for sampling
- Double checking a HASS profile

Specifications for HALT & HASS
- IEST Recommended Practice (Draft)
- Common Mistakes (from RP)
- HASS Process Without Prior HALT

Summary, Final Review

Award of Certificates for Successful Completion

Technology Training, Inc.
(a tti group company)
Toll-free telephone:
866-884-4338 (866-TTi-4edu)
805/845-5050
E-mail: Training@ttiedu.com
http://www.ttiedu.com