

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 using stress testing for product development and design verification.

BRIEF COURSE DESCRIPTION This course shows why Environmental Stress Screening (ESS) and its modern descendants, 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 used 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/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](#).

DIPLOMA PROGRAMS This course is required for TTI's [Climatic Test Specialist \(CTS\)](#) and [Mechanical Design Specialist \(MDS\)](#) diploma programs. It may be used as an elective for any other [TTI specialist diploma program](#).

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

INTERNET COMPLETE COURSE 240 features almost ten hours of video as well as more in-depth reading material. All chapters of course 240 are also available as OnDemand Internet Short Topics. See the on-line course outline for details.

COURSE HOURS, CERTIFICATE AND CEUs 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.

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)

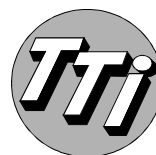
Comparison with ESS • Writing a HASS Profile
Two common types of profiles for HASS
Ramp Rates and Dwell Times • Precipitation Screen
Number of Cycles • Guidance for sampling
Double checking a HASS profile

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



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