

# Vibration and Shock Measurement & Testing

for Land, Sea, Air, Space Vehicles & Electronics Manufacture

**April 1-3, 2009**

College Park, Maryland

**April 14-16, 2009**

Fullerton, California

**May 11-13, 2009**

Dayton, Ohio

**\$2595** (8:00am - 4:00pm)

"Also Available As A Distance Learning Course"  
(Call for Info)

"Register 3 or More & Receive \$100<sup>00</sup> each  
Off The Course Tuition."

## Instructor

**Wayne Tustin** is President of Equipment Reliability Institute (ERI), a specialized engineering school and consultancy. His BSEE degree is from the University of Washington, Seattle. He is a licensed Professional Engineer - Quality in the State of California. Wayne's first



encounter with vibration was at Boeing/Seattle, performing what later came to be called modal tests, on the XB-52 prototype of that highly reliable platform. Subsequently he headed field service and technical training for a manufacturer of electrodynamic shakers, before establishing another specialized school on which he left his name. Wayne has written several books and hundreds of articles dealing with practical aspects of vibration and shock measurement and testing.

## What You Will Learn

- How to plan, conduct and evaluate vibration and shock tests and screens.
- How to attack vibration and noise problems.
- How to make vibration isolation, damping and absorbers work for vibration and noise control.
- How noise is generated and radiated, and how it can be reduced.

**From this course you will gain the ability to understand and communicate meaningfully with test personnel, perform basic engineering calculations, and evaluate tradeoffs between test equipment and procedures.**

## Summary

This three-day course is primarily designed for test personnel who conduct, supervise or "contract out" vibration and shock tests. It also benefits design, quality and reliability specialists who interface with vibration and shock test activities.

Each student receives the instructor's brand new, minimal-mathematics, minimal-theory hardbound text Random Vibration & Shock Testing, Measurement, Analysis & Calibration. This 444 page, 4-color book also includes a CD-ROM with video clips and animations.

## Course Outline

**1. Minimal math review of basics of vibration, commencing with uniaxial and torsional SDOF systems.** Resonance. Vibration control.

**2. Instrumentation.** How to select and correctly use displacement, velocity and especially acceleration and force sensors and microphones. Minimizing mechanical and electrical errors. Sensor and system dynamic calibration.

**3. Extension of SDOF** to understand multi-resonant continuous systems encountered in land, sea, air and space vehicle structures and cargo, as well as in electronic products.

**4. Types of shakers.** Tradeoffs between mechanical, electrohydraulic (servohydraulic), electrodynamic (electromagnetic) and piezoelectric shakers and systems. Limitations. Diagnostics.

**5. Sinusoidal one-frequency-at-a-time vibration testing.** Interpreting sine test standards. Conducting tests.

**6. Random Vibration Testing. Broad-spectrum all-frequencies-at-once vibration testing.** Interpreting random vibration test standards.

**7. Simultaneous multi-axis testing** gradually replacing practice of reorienting device under test (DUT) on single-axis shakers.

**8. Environmental stress screening (ESS)** of electronics production. Extensions to highly accelerated stress screening (HASS) and to highly accelerated life testing (HALT).

**9. Assisting designers** to improve their designs by (a) substituting materials of greater damping or (b) adding damping or (c) avoiding "stacking" of resonances.

**10. Understanding automotive** buzz, squeak and rattle (BSR). Assisting designers to solve BSR problems. Conducting BSR tests.

**11. Intense noise** (acoustic) testing of launch vehicles and spacecraft.

**12. Shock testing.** Transportation testing. Pyroshock testing. Misuse of classical shock pulses on shock test machines and on shakers. More realistic oscillatory shock testing on shakers.

**13. Shock response spectrum (SRS)** for understanding effects of shock on hardware. Use of SRS in evaluating shock test methods, in specifying and in conducting shock tests.

**14. Attaching DUT** via vibration and shock test fixtures. Large DUTs may require head expanders and/or slip plates.

**15. Modal testing.** Assisting designers.