

ENDEVCO ACCELEROMETER CALIBRATION WORKSHOP

I. VIBRATION

INTRODUCTION TO DYNAMIC MOTION

Whole Body Motion vs Deformation

Single Degree of Freedom System

Free Vibration, Natural Frequency, Damping

Forced Vibration, Resonance, Transmissibility

Multiple Degrees of Freedom, Continuous Systems, Modal Analysis

TERMS, DEFINITIONS, AND EQUATIONS OF MOTION

Single Frequency and Multiple Frequency Excitation

Displacement, Velocity, Acceleration Relationships

Vibration Calculator and Nomograph

Peak, RMS, dB, ISO Reference Levels

COMPLEX VIBRATION, RANDOM VIBRATION

Periodic vs Non-periodic motion

II. SHOCK MOTION AND THE PHYSICS OF SHOCK

Terms and Definitions

Classical Pulses and Complex Transients

III. HOW SHOCK AND VIBRATION ARE MEASURED

Optical and Fixed-reference Measurements

Seismic Transducers

Measuring Displacement (Including Laser Interferometer)

Measuring Velocity (Including Laser Doppler Velocimetry)

Measuring Acceleration

IV. SHOCK CALIBRATION

Shock Calibration Techniques and Systems

Drop Ball

SMAC

Shock Calibration Instrumentation

V. ELECTRODYNAMIC SHAKERS AND CONTROLS

Theory of Operation

Unwanted Motions

Power Amplifiers

Analog and Digital Controls

Special Designs for Calibration Shakers

VI. ACCELEROMETER PERFORMANCE CHARACTERISTICS AND ERROR SOURCES

- Mass Loading, Mounting Effects and Case Strain (Including Acoustic Response)
- Frequency Response; Low, High, Resonance
- Phase Shift and Damping
- Transverse Motion & Sensitivity
- Range and Linearity
- Temperature Response and Thermal Transient Response
- RF and Magnetic Fields
- Zero Shift
- Stability and Aging

VII. REFERENCE ACCELEROMETER CHARACTERISTICS

- Design
- Linearity
- Frequency Response
- Loading by Unit Under Test
- Stability

VIII. SIGNAL CONDITIONING

- Piezoelectric Conditioners, Voltage and Charge
- Isotron Conditioners
- PR and VC Signal Conditioners
- Frequency Response and Filtering
- Noise Sources, Noise Rejection, Isolation and Shielding
- Signal Distortion Problems
- Ranging, Overload, Saturation, and Clipping
- Slew Rate and Phase Shift Distortions
- Programmable Signal Conditioners
- Automated Calibration Systems

IX. DO'S AND DON'TS OF CALIBRATION

X. STATISTICS, ERROR ANALYSIS, ACCURACY AND UNCERTAINTY

- Normal (Gaussian) Distribution
- Characteristics and Parameters
- Error Contributions and Combining Errors
- Error Analysis, Accuracy and Uncertainty

XI. CALIBRATION STANDARDS AND SPECIFICATIONS

- ISO
- MIL
- ANSI
- ISA

XII. HANDS-ON CALIBRATION SYSTEM DEMONSTRATIONS

Demonstrations and hands-on will include as many different calibration systems as can be made available. Text is "Shock and Vibration Measurement Technology" supplemented by Endevco Tech Papers and other hand-outs prepared specifically for this course.