Improved Primary Accelerometer Calibration via Laser Interferometry

Mark I Schiefer

The Modal Shop
ISO 16063 Methods for the Calibration of Vibration and Shock Transducers

- 16063 Part 11. Primary vibration calibration by laser interferometry
- 16063 Part 13. Primary shock calibration by laser interferometry
- 16063 Part 21. Vibration calibration by comparison method
- 16063 Part 22. Shock calibration by comparison method
ISO 16063 Part 21

Comparison - Back to Back Method

Reference uncertainty is dominant factor in cal

\[ A_a = A_{\text{ref}} \]
\[ \frac{V_a}{S_a} = \frac{V_{\text{ref}}}{S_{\text{ref}}} \]
\[ S_a = S_{\text{ref}} \frac{V_a}{V_{\text{ref}}} \]

Accelerometer to be calibrated
Calibration Standard Accelerometer (Known sensor \( S_{\text{ref}} \))
Shaker
Acceleration
ISO 16063 Part 11

• Michelson Interferometer operational schematic
Primary System Methods

• Method 1: Fringe-Counting
• Method 2: Minimum-Point
• Method 3: Sine Approximation
Method III Primary System

- Data intensive
- Most accurate
- Provides Phase information
- Implemented as reference option to 9155
Error Contributions

Error Contribution 100 & 159Hz

Error Contribution 5k-15k Hz
Transverse Comparison

- Flexure based shakers rarely meet transverse motion recommendations
Vibration Exciter

- The key to good calibrations
  - Low rocking and transverse motions
  - Simplicity and reliability of use
K394A30/31 Vibration Exciter
Improved implementation

- Dual Beam-Dual pass Homodyne Laser
Interferometer Head

Each small, light-weight head contains
- integrated dual-pass optics
- specialized phase sensitive detector
- differential preamplifier

Compact optics
Large (3mm) spot
Dual pass
Alignment
Linear Detector
Low Frequency Reference

- Long-stroke ABS reference is traditionally an accelerometer
- What if we replace this with a displacement sensor?
- Optical displacement
- No drift, alignment
- No resolution reduction
- Inexpensive
- Great for < 20 Hz
Low Frequency Reference
Conclusion

• Vibration Excitation is key
• Simple reliable setup and positioning
• Dual Beam Dual Pass interferometer
• Low frequency improved reference

For further information, contact:
Mark Schiefer (mschiefer@modalshop.com)
Or visit us at www.modalshop.com

Thank you very much for attending!!