

DYNAMIC PRESSURE MEASUREMENT TECHNOLOGY COURSE OUTLINE

I. Introduction

- General Measurement Systems
- Pressure Fundamentals
- Basic Definition
- Pascal's Law
- A Weight Generates Pressure
- Pressure of a Fluid Column
- Reference Pressure
- Definitions of Pressure Terminology
- Vacuum and Absolute Pressure
- Dynamic Pressure
- Measurement of Dynamic Pressures
- Acoustic and Fluid Flow Effects
- Acoustic Limitation of a Pressure Probe
- Dynamic Response of Transducer in Liquid System

II. Pressure Measurement Instruments

- Manometers
- Mechanical Pressure Gauges
- Pressure Transducers
- General Description
- Theory of Operation
- Transducer Types
- Scanners
- Pressure Scanning Valves
- Electronic Pressure Scanners
- Microphones
- Introduction to Acoustics
- Acoustic Sensitivity
- Vibration Sensitivity
- Sensing Elements
- Discrete Gages
- Integral Gages
- Sensing Bridge
- Transducer Design
- Diaphragm Characteristics
- Integral Compensation
- Mechanical Design

III. Performance Characteristics

- Dynamic Range
- Definition
- Range
- Overrange
- Sensitivity
- Sensitivity Calibration
- Polarity
- Nonlinearity, Hysteresis and Nonrepeatability
- Definitions

- Nonlinearity
- Hysteresis
- Non-repeatability
- Combining Nonlinearity, Hysteresis and Non-repeatability
- Zero Measurand Output (ZMO)
- Mounting Effects
- Warm-up
- Thermal Stability
- Zero Shift (Max at 3x Range)
- Effect of Overpressure
- Phase Shift
- Input. and Output Resistance
- Thermal Sensitivity Shift and Zero Shift
- Thermal Sensitivity Shift
- Thermal Zero Shift
- Thermal Transient Response
- Filtering Out Thermal Zero Drift
- Flash Response
- Methods to Reduce Flash Response
- Transducer Resonance Frequency
- Frequency Response
- Low Frequency Response
- High Frequency Response
- Rise Time and Response Time
- Acceleration Sensitivity
- Burst Pressure
- Full Scale Output
- Supply Voltage or Excitation

IV. Environmental Limits

- Diaphragm Loading
- Temperature
- Acceleration, Shock and Vibration
- RF and Magnetic Fields
- Sealing and Hermeticity
- Media Compatibility
- Pressure Sensitive End
- Electrical Lead End
- Nuclear Radiation

V. Application Information

- Connection Diagram
- Mounting Techniques
- Strain Sensitivity
- Insulation
- Cabling
- Standard Cables
- Splicing and Extension Cables
- Loading Effects
- Effects of Cable on Transducer Sensitivity
- Balancing Zero Measurand Output

VI. Electronics

- Power for Excitation
- DC Power Supplies
- AC Excitation
- Signal Conditioning
- Amplifiers
- Programmable Signal Conditioners
- Readout and Recording Devices
- Errors in Digitizing Systems

VII. Measurement of Transient Pressure Pulses

- Dynamic Range
- Low Frequency Response
- High Frequency Response
- Phase Shift
- Digital Transient Recording
- Special Considerations for Air Blast Measurements
- Rise and Response Times
- Spatial Averaging of Pressure Across Diaphragms
- Mechanical Protection

VIII. Calibration

- Temperature Calibrations
- Electrical Calibrations
- Static Calibrations
- Dead Weight Testers
- Precision Gages
- Pressure Calibration Systems
- Dynamic Calibrations
- Oscillating Pressure Calibrations
- Step Pressure Generators

IX. Selection and Application

- Selection Criteria
- Applications Check List
- Pressure Level to be Measured
- Proof Pressure
- Burst Pressure (Also termed Ultimate)
- Pressure Media
- Temperature
- Other Considerations
- Cost
- Allowable Error Breakdown
- Product Information
- Identification
- Range
- Sensitivity
- Excitation
- ZMO (Zero Measurand Output)
- Full Scale Output
- Nonlinearity
- Hysteresis

- Nonrepeatability
- Combined Linearity, Hysteresis & Nonrepeatability
- Thermal Zero Shift
- Zero Shift after 3x Full Scale
- Thermal Sensitivity Shift
- Input and Output Resistance
- Isolation Resistance
- Plotted Nonlinearity
- Plotted Thermal Zero Shift, Thermal Sensitivity Shift
- Installation Check List
- Is the Transducer in Good Condition and Ready to Use?
- Cable
- Power Supply
- Amplifier
- Readout

X. Maintenance and Recalibration

- Quick Checks
- Impedance Test
- Insulation Resistance
- Zero Measurand Output
- Transducer Maintenance
- Recalibration
- Cable Maintenance
- Cable Attachment
- Cable Protection

XI. Glossary and Unit Conversions

- Glossary
- Pressure Unit Conversions
- Units of Measurement
- Decibel Formulas
- Pressure vs. Altitude

XII. Bibliography and References

- Appropriate Endevco Literature
- Publications, Books, Technical Papers
- Standards

XIII. Appendices

- Example Test Report
- Selection Guide