
Ultrasonic Meters (Instructor-Led Training)

Course Description

This course covers ultrasonic flow meters, their operating theory, and considerations for installation, maintenance and operation.

Course Prerequisites

- GTA Web-Based Training
 - Core WBT
 - Statistics and Uncertainty
 - Gas Properties I
 - Gas Properties II
 - Ultrasonic Meters I
 - Ultrasonic Meters II
- GTA Instructor-Led Training
 - Measurement Systems

Course Objectives

Upon completion of this course, the student will have received instruction designed to assist him/her in the following:

- Define various terms used for ultrasonic flow meters.
- Discuss AGA 9 and AGA 7.
- Discuss the general principals involved in how ultrasonic signals are used to measure flow.
- Discuss bounce-path ultrasonic flow meters.
- Discuss chordal-path ultrasonic flow meters.
- Discuss maintenance and inspection requirements for ultrasonic meters.

Course Outline

1. AGA 9 and AGA 7 Flow Calculations
 - a. AGA 9 Table of Contents (April 2007)
 - b. Check or Operational Meters
 - c. Custody Transfer Meters
2. Theory of Operation
 - a. Gas Law Review
 - i. Boyle's Law
 - ii. Charles Law
 - iii. Ideal Gas Law
 - b. Continuity of Flow
 - i. Examine Gas Flow Properties
 - ii. Flow Characteristics
 - iii. Reynolds Number
 - c. Ultrasonic Meter Introduction
 - i. Acoustic Path Length
 - ii. Acoustical Transient Time
 - iii. Speed of Sound
 - iv. Transit Time Calculations
 - v. Example Flow Calculation
 - vi. Transit Time Example
 - vii. General Requirements for Accurate Ultrasonic Flow Measurement
 - d. Path Configurations and Uses
 - i. Path Configuration Examples
 1. Single-Path Single-Reflective
 2. Two-Path Double-Reflective
 3. Three-Path Meters: Combination of Both
 4. Four-Chord USM
 5. Single-Path Bounce Reflective
 - e. General Physical Properties

- i. Transducer Types
 - ii. Retractable Transducer Assemblies
 - iii. Path Label and Bleed Valve
 - iv. Transducer Pressure Label
 - v. Transducer Factory Mutual Acceptance (FM) Label
 - f. 3-D Model of Gas Flow Profiles
 - i. Laminar Flow Profile
 - ii. Turbulent Flow Profile
 - iii. Electronic Inputs/Outputs
 - g. Meter Capacity Comparisons
 - h. Dry Calibration
 - i. AGA 9 Performance Summary
 - i. AGA 9 Requirements for Meters ≤ 12 " NPS
 - ii. AGA 9 Requirements for Meters > 12 " NPS
 - j. Ultrasonic Meter Flow Calibration
 - i. Advantages and Disadvantages of Ultrasonic Meters
 - ii. Installation Recommendations
 - iii. Typical Installation
- 3. Bounce-Path Ultrasonic Flow Meters
 - a. Theory of Operation
 - b. Single-Path Meter
 - c. Three-Path and Five-Path Meters
 - d. Design Criteria
 - e. Installation Considerations
 - f. Field Wiring Considerations
 - g. Electronics Interface
 - h. Meter Configuration
 - i. Pre-Startup Considerations
 - j. Meter Components
 - i. Signal Processing Unit and Central Processing Unit

- ii. Modes of Operation
 - iii. Output Settings
 - k. Uniform Software
 - i. System Requirements
 - ii. Shortcut Keys
 - iii. Installing Software
 - iv. Programming a New Setup
 - l. Monitoring an Ultrasonic Flow Meter
 - i. Quitting UNIFORM
 - ii. Average Monitoring
 - iii. Changing Input Calibration for PTZ
 - iv. Output Test
 - v. Setting the Graph Properties
 - vi. Running a Data Log
 - vii. Alarm and Error Codes
 - viii. Error Codes
 - ix. Troubleshooting Communication Problems
 - x. Meter Troubleshooting Checklist
 - xi. Problems Reading From the Meter
 - m. Troubleshooting the Bounce-Path Flow Meter
 - n. Performance
 - i. AGC Levels (Automatic Gain Control)
 - ii. AGC Limit (Automatic Gain Control)
 - iii. Sample Rate
 - iv. DiagBits
- 4. Chordal-Path Ultrasonic Meter
 - a. Terminology
 - b. Theory of Operation
 - c. Meter Accuracy
 - d. Design Criteria

- e. Installation Requirements
 - i. Mechanical Installation
 - ii. Electronics Installation
 - iii. Installation of Main Electronics to Meter Body (if required)
 - f. Meter Components
 - i. Main Electronics
 - ii. Man Machine Interface
 - g. System Requirements
 - i. Installing Mk III Drivers
 - ii. CUI Software
 - 1. Connecting
 - iii. Meter Test Report Items
 - iv. Setting up a Meter Using the Field Setup Wizard
 - v. Common Failures
 - vi. Communications Settings
 - vii. Troubleshooting the Chordal-Path USM
 - viii. Gain
 - ix. Velocity Profile
 - x. Routine Checks
 - xi. Communication Errors
5. Maintenance and Inspection Requirements
- a. Inspections
 - i. Installation Inspection
 - ii. Routine Inspection
 - iii. Annual Inspection
 - b. Post-Activity Requirements
 - i. Flow Computers
 - ii. General Electronics
 - iii. Frequency Output Devices
 - iv. Frequency Output Accuracy Check

- v. Full-Span Accuracy Inspection
- c. Safe Retraction, Removal, and Replacement of Ultrasonic Transducers
 - i. Instromet
 - 1. Removal Procedure
 - 2. Installation Procedure
- d. Daniel Procedures
 - i. Installation Procedure
- e. Ultrasonic Meter monthly Maintenance Requirements
 - i. Long-Term Maintenance

Recommended Resources

- GTA Ultrasonic Meters Participant Guide and Instructor Presentation.
- AGA Reports 5, 7, 8, and 9.
- Internet sites and textbooks related to ultrasonic meters.