

Gas Measurement Fundamentals & Electronic Flow Meter Recommended Best Practices

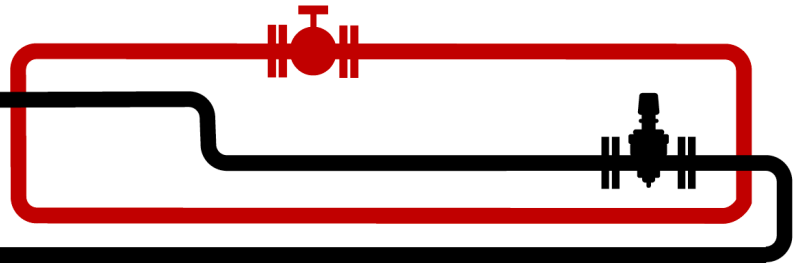
Gas Measurement Fundamentals (1.5 Days)

- I. Gas Measurement Fundamentals**
 - A. Natural Gas Chemistry
 - B. Physical Behavior
 - 1. Gas Laws
 - 2. Specific Gravity
 - 3. Gas and Liquid Density

- II. Units of Measurement**
 - A. Base Conditions
 - 1. Absolute, Gauge, and Atmosphere Pressure
 - 2. Temperature
 - 3. Contract Pressure Base
 - B. Standard Cubic Feet
 - C. Heating Valve
 - D. Mass

- III. Volume Determinations Measurement Devices**
 - A. Orifice Meter
 - 1. Primary Element
 - 2. Secondary Element
 - 3. Chart Calculations
 - 4. Measurement Problems
 - B. Gas Orifice Meter
 - 1. Basic Flow Equations
 - 2. Beta Ratio
 - 3. Basic Orifice Flow Factor
 - C. Positive Displacement Meters
 - 1. Rotary Meters
 - 2. Diaphragm Meter
 - 3. Flow Calculations
 - 4. Sample Problems





Electronic Flow Meter (EFM) Recommended Best Practices (2.5 Days)

I. Orifice Meter Test Procedures for Chart Recorders

- A. Introduction
- B. Test Equipment
- C. Documentation (Test Report)
- D. The Meter Test
- E. Completing the Test Report

II. Witnessing Meter Test Inspections

- A. Measurement Witnessing Checklist
 - 1. Before Calibration
 - 2. Take Gas Sampling Calibration
 - 3. Differential Pressure Device
 - 4. Static Pressure Device
 - 5. Resistance Temperature Detector (RTD)
 - 6. Orifice Plate
 - 7. After Calibration
 - 8. Paperwork

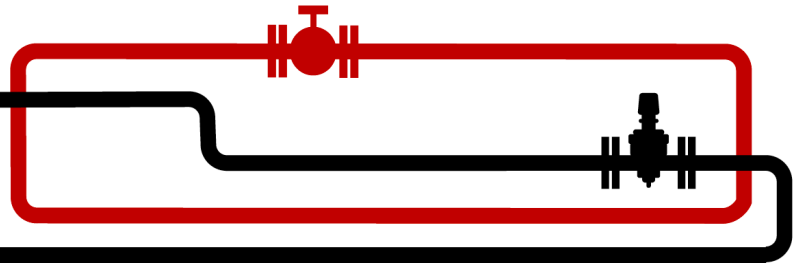
III. Charts and Chart Recorders

- A. Types of Charts
 - 1. L-10
 - 2. Square Root
- B. Recorders
 - 1. Pressure
 - 2. Temperature
 - 3. Calibration and Maintenance

IV. Control of Pulsation-Induced Measurement Error

- A. What is Pulsation?
 - 1. Definition
 - 2. Field Causes
- B. Measurement Effects on Primary Element
 - 1. Square Root Error (SRE)
 - 2. How to Calculate SRE
 - 3. Gas Contract Limits
 - 4. Industry Standards
 - 5. How to Measure SRE
 - 6. How to Reduce Pulsation-Induced SRE Error
- C. Measurement Effects on Secondary Element
 - 1. Gauge Line Error (GLE)
 - 2. How to Calculate GLE
 - 3. How to Measure GLE
 - 4. How to Reduce Pulsation-Induced GLE Error





Electronic Flow Meter (EFM) Recommended Best Practices *(cont.)*

V. Odorization

- A. Why Odorize?
 - 1. New London Accident History
 - 2. Federal Code (CFR 49 192.625)
- B. How Much is Enough?
 - 1. How to Measure
 - 2. What is LEL?
 - 3. What is Readily Detectable?
- C. Safety

VI. Gas Sampling and Chromatographic Gas Analysis

- A. Introduction
- B. Sampling Methods
- C. Transportation
- D. Sample Preparation
- E. Chromatographic Gas Analysis

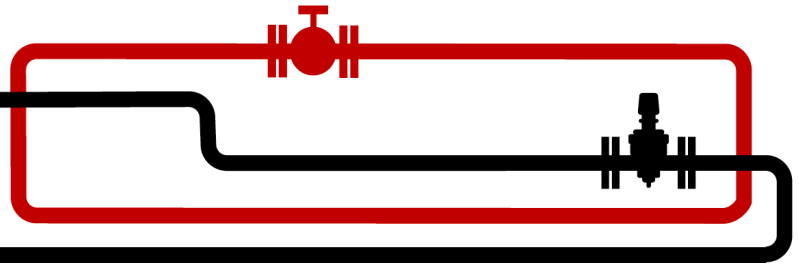
VII. Techniques of Gas Spot Sampling

- A. Payment
- B. Sample Point Location
- C. Sample Valves
- D. Sample Cylinders and Cylinder-Related Equipment
- E. Department of Transportation
- F. Spot Sampling Methods
 - 1. GPA Fill and Empty Method
 - 2. GPA Continuous Purge Method
 - 3. GPA Method for Taking Spot Sample in an Evacuated Cylinder or Standard Sample Cylinder Filled with an Inert Gas
 - 4. Drawing a Spot Sample Into a Constant Pressure (Sliding Piston) Sample Cylinder
 - 5. Installation of a Continuous Sampler
 - 6. Installation of an On-Stream Analyzing Device

VIII. Moisture and H₂S Analyzers

- A. Introduction
- B. Operation
- C. Installation and Maintenance





Electronic Flow Meter (EFM) Recommended Best Practices *(cont.)*

- IX. Inspecting Orifice Meters**
 - A. Importance of Inspecting a Meter
 - B. Taking a Meter Out of Service
 - 1. Equipment and Materials Required
 - 2. Inspection
 - a. Physical Dimensions
 - b. Flange Faces
 - c. Flange Two-Bolt Level
 - d. Flange Tilt
 - e. Bad or Poorly Finished Welds
 - f. Communication between Tap Holes
 - g. Straightening Vane Location
 - 3. Tap Holes
 - 4. Orifice Plate Centering
 - 5. Tube Internal Diameter
- X. Meter Tube Inspection Sheets**
 - A. Importance of Inspection Reports
 - B. How to Fill Out Meter Tube Inspection Reports
 - C. Orifice Fitting Blank Plate Leakage Test
- XI. Gas Chromatograph (GC)**
 - A. What it is and Relation to Measurement
 - B. Operation and Internals
 - C. The Effects of Liquids
 - D. Maintenance
 - E. Online versus Portable
- XII. Lab Procedures for Chromatographic Natural Gas**
 - A. Log-in Procedures
 - B. Sample Preparation
 - C. Gas Chromatography Procedures
 - D. Hexanes Plus BTU Analysis (GPA Method 2261)
 - E. Extended Gas Analysis (GPA Method 2286)
 - F. BTU History and Review Process
 - G. Cylinder Cleaning
- XIII. Flow Computers and Their Application**
 - A. Review of AGA 3 (Old vs. New)
 - B. Components of a Flow Computer
 - C. Sensing Elements
 - 1. Pressure
 - 2. Temperature
 - 3. Differential Pressure
 - 4. Multivariable Transmitters
 - D. Communication and Configuration
 - E. Power Supply and Consumption
 - 1. Solar Panels
 - 2. Maintenance Concerns
 - F. New Technologies

