International School of Hydrocarbon Measurement
Fundamentals of Natural Gas Measurement

This course is designed to provide the student with a foundational understanding of the core principles that define the determination of natural gas quantitative and qualitative values as such are generally derived and applied within the energy industry. The course consists of eleven hours of detailed classroom instruction scheduled over three days of the School. Students will be provided with a text of the course materials.

Course Curriculum

1. **Measurement Ethics**
2. **Units of Measure**
    a. Pressure
    b. Temperature
    c. Volume
    d. Mass
    e. Density
    f. Viscosity
    g. Heating Value
3. **Standard Conditions**
    a. Pressure Base (Volumetric)
    b. Pressure Base (Energy)
    c. Temperature Base
4. **Fundamental Gas Laws**
    a. Boyle's Law
    b. Charles' Law
    c. Gay-Lussac's Law
    d. Ideal Gas Law
    e. Real Gas Law
    f. Dalton's Law of Partial Pressure
    g. Avogadro's Law
5. **Natural Gas Chemistry and Physical Properties**
    a. Component of Natural Gas
        i. Hydrocarbons
            1. Methane
            2. Ethane
            3. Propane
            4. Iso Butane
            5. Normal Butane
            6. Iso Pentane
            7. Normal Pentane
            8. Normal Hexane
            9. Normal Heptane
            10. Normal Octane
            11. Normal Nonane
            12. Normal Decane
        ii. Non-Hydrocarbons
            1. Nitrogen
            2. Carbon Dioxide

3. Oxygen
4. Hydrogen Sulfide
5. Water

b. Quality Determinations from Composition
   i. Compositional Determination
      1. Chromatography
   ii. Quality Determination from Composition
      1. Compressibility
      2. Heating Value
         a. Gross Heating Value
            i. Ideal
            ii. Real
         b. Heating Value Conditions
      3. Relative Density
         a. Ideal
         b. Real
      4. Theoretical Liquid Hydrocarbon Content
         a. Ideal
         b. Real

6. Measurement Elements and Fluid Flow Calculations

a. Primary Elements
   i. Orifice Meter
   ii. Turbine Meter
   iii. Ultrasonic Meter
   iv. Positive Displacement Meter
   v. Coriolis Meter
   vi. Other Meter Types
b. Secondary and Tertiary Elements
c. Fluid Flow Calculations
   i. Orifice Meter Flow Calculations
   ii. Linear Meter Flow Calculations
   iii. Volumetric Quantities per Flow Rate Determination
d. Elemental Variance, Error Calculations and Variable Averaging
   i. Elemental Variance Determination
      1. Pressure
         a. Static
         b. Differential
      2. Temperature
      3. Other
   ii. Square Root Error
   iii. Averaging Methods
      1. Root Mean Squared
      2. Flow Weighted versus Time Weighted

7. Total Energy Determination