CCAC Oil and Gas Methane Partnership: Methane Emissions Detection and Measurement Techniques, Equipment and Costs
Emissions Detection And Quantification - Overview

- A field emissions detection and quantification survey (similar to a Directed Inspection and Maintenance (DI&M) practice) recommended
  - Initial (baseline) survey
  - Subsequent surveys are based on data from previous surveys

- **Direct measurement**
  - is deemed as the most accurate method for quantifying annual methane emissions
  - contributes to greater certainty on emissions levels and economic costs and benefits
  - Allows for decisions based on fact, and accurate field data
Emissions Detection And Quantification – Overview

➢ Identification:
  ▪ Optical leak imaging (IR camera)
  ▪ Laser leak detector (RMLD)
  ▪ Soap bubble screening
  ▪ Organic Vapor Analysers (OVAs) and Toxic Vapor Analysers (TVAs)
  ▪ Acoustic Leak Detection

➢ Quantification:
  ▪ Turbine meters
  ▪ Thermal Dispersion Flow Meters
  ▪ Calibrated vent bag
  ▪ Vane anemometer
  ▪ Hotwire anemometer
  ▪ High volume sampler
Optical Leak Imaging (IR Camera)

- Scans the leak area in real time
- Applicable for cold/hot temperature environments
  - Recommended operating temperature ranges from -20 to 50°C (-4 to 122 °F)
- Capable of screening hundreds of components per hour
- Requires no calibration
- The only change required might be replacement of lenses for detecting emissions from longer distances
- Purchase cost: from $85,000 to $115,000

Source: Natural Gas STAR, Heath Consultants
Laser Leak Detector (RMLD)

- Only detects methane gas
- Detects from a maximum distance of 30 meters (100 feet)
- A background surface within 34 meters (110 feet) from the device is necessary

- Useful for detecting methane leaks originating from hard-to-reach sources and/or throughout difficult terrain
- Can quickly screen hundreds of components per hour
- Purchase cost: [cost being verified with Heath]
Laser Leak Detector (RMLD)

- Shows methane concentration in parts per million per meter (ppm-m) of beam pathlength
  - Cannot be converted to the quantity of gas leakage
  - Measurement range: 0 to 99,999 ppm-m
  - Sensitivity:
    - 5 ppm-m at distances from 0 to 15 meters (0 to 50 feet)
    - 10 ppm-m and higher at distances from 15 to 30 meters (50 to 100 feet)

- Operating temperature: from -17 to 50 °C (0 to 122 °F)
- Relative humidity range: 5-95%
- Weight: 4.5 kilograms (10 pounds)
- Operates on a rechargeable internal lithium-ion battery pack:
  - Lasts for up to 8 hours

Source: Natural Gas STAR
Soap Bubble Screening

- Quick and low-cost
- Effective for locating loose fittings and connections
- **Not** effective on large openings
- Screening: ~100 components per hour
- Cannot be used on equipment above the boiling point of water (100 °C/212 °F) or below the freezing temperature of water (0 °C/32 °F)
- Costs: < $100
Organic Vapor Analysers (OVAs) and Toxic Vapor Analysers (TVAs)

- **OVA:**
  - Measures the organic vapor concentration ranging from 9 to 10,000 ppm

- **TVA:**
  - Measures organic vapor concentrations over 10,000 ppm

In combination can measure methane concentration in the area surrounding a leak over a large range

Concentrations can be converted to an approximate mass emissions rates using SOCMI correlation equations

- Slow: each device can survey ~40 components per hour

- Require frequent calibration

- Costs: < $10,000

Source: Natural Gas STAR,
Acoustic Leak Detectors

- Applicable to internal through valve leaks
- Can detect either high or low frequency signals
- Useful for detecting leaking valves when the vent is inaccessible
- Scan from distances up to 30 meters (100 feet)
- Have frequency tuning capabilities
- Particularly useful for inaccessible components, larger leaks, and pressurized gas
- Costs: $1,000 - $20,000 depending on instrument sensitivity, size, and any associated equipment/parts

Source: Natural Gas STAR, 9
Turbine Meters

- Used for flows exceeding or equal to 0.283 standard m$^3$/minute or 10 scf/minute; good for higher volume tank measurements
- Measure cumulative flow volume
  - Can be converted to standard volume using the temperature and pressure of the gas
- Allow continuous and automated measurement with a recording device
- Accuracy:
  - ±1 percent if within the stated flow range
  - ±25 percent if outside of the stated flow range
- Operational temperature: -18 to 104 °C (0 to 219 °F)
- Do not require field calibration; works well in high BTU gas
- Requires a good seal between the venting line and the meter itself
- Need to insure a separate pressure relief system is working
- Costs: $4,000

Source: Natural Gas STAR, SPER Direct, AKS METERS, Prosource Scientific, REED, HY-BON.
Extremely versatile meter, handling extremely large gas flows of extremely wet, high BTU gas; while also covering lower ranges effectively.

Inserted in the gas flow from an open ended pipe or through a port in a gas flow pipeline or flare line.

Probe configurations: ½” to 24” diameter pipe (multiple probe lengths)

Flow Measurement System can be permanently mounted for continuous monitoring
  - Flare stacks
  - Open ended Vents

Flow profile generation; works very well in wet, high BTU gas

Data logging saved to USB and opened in Excel

Measureable flow velocity range: 0.2 – 100 feet per second (ft/s)
  - can be translated into a volumetric flow rate

Operating temperature: -40 to 121 °C -40 to 250 °F)

Factory Calibrated on NIST traceable flow stands;
  - No field calibration required

Costs: $4,500 to $8,500

Source: Hy-bon Engineering
Calibrated Vent Bag

- Measurement is made by timing the bag expansion to full capacity; not recommended for very large volume streams
- Does not exert a significant back pressure on the vented component
- Allows for low-pressure drop measurements
- Requires no additional power source
- Can be reused up to ~100 times
- Measurement of gas temperature and composition is required
- Measurable leak range: 17 m³/hour (600 ft³/hour) - 408 m³/hour (14,400 ft³/hour)
- Measurable temperature range: 0 to 49 °C (32 to 120 °F)
- Accuracy: ±10 percent
- Costs: $50 per bag

Source: Natural Gas STAR, Heath Consultants
Vane Anemometers

- Best for measuring open ended lines and end-of-pipe vents of known cross-sectional area; typically used for wind speed
- Do not require complete capture of emissions
- Volumetric flow rate = Cross-sectional area x flow velocity
- Measuring range of gas flow velocity: 0.4 - 80 meters/second
- Measuring uncertainty: 0.9%-1.5% of gas velocity
- Working temperature:
  - Wheel sensor: -15 to 260 °C (5 to 500 °F)
  - Handheld sensor: 0 to 50 °C (32 to 122 °F)
- Measurement of gas temperature is required
- Avoid using when the device exerts a backpressure on the measured vent
- Require calibration
- Costs: $1,400 - $5,500

Source: SPER Direct, AKS METERS, Prosource Scientific, REED.
High Volume Sampler

- Converts calibrated air flow and hydrocarbon concentration to a volumetric flow rate of the gas sucked into the device
- Designed to capture the total amount of the emissions from a leaking component or vent line; best on small volume leaks
- Measures combustible hydrocarbon concentrations in the captured air stream ranging from 0.01% to 100%
- Does not distinguish between methane and heavier hydrocarbons
- Measureable leak rate: 0.02 - 18 m³/hour (1 - 630 ft³/hour)
- Operating temperature: 0 to 50 °C (32 to 122 °F)
- Accuracy: ±10%
- Max capacity: 14 m³/hour (480 ft³/hour)
- Calibration is recommended every 30 days
- Costs: $17,500 + $1,200 (calibration kit)

Source: Natural Gas STAR, Heath Consultants
Extended Gas Analysis is often needed to accurately design VRUs, flares, or other control technologies.

- Captures quality atmospheric tank vapor gas samples
- Low pressure gas line sampling
- Stainless steel sample canisters for pressurized samples
- Battery operated – 12 volt
- Allows for quick, accurate gas samples from the true source
- Costs: $3,500 to $5,000

Source: Hy-bon Engineering
THANK YOU!

www.unep.org/ccac