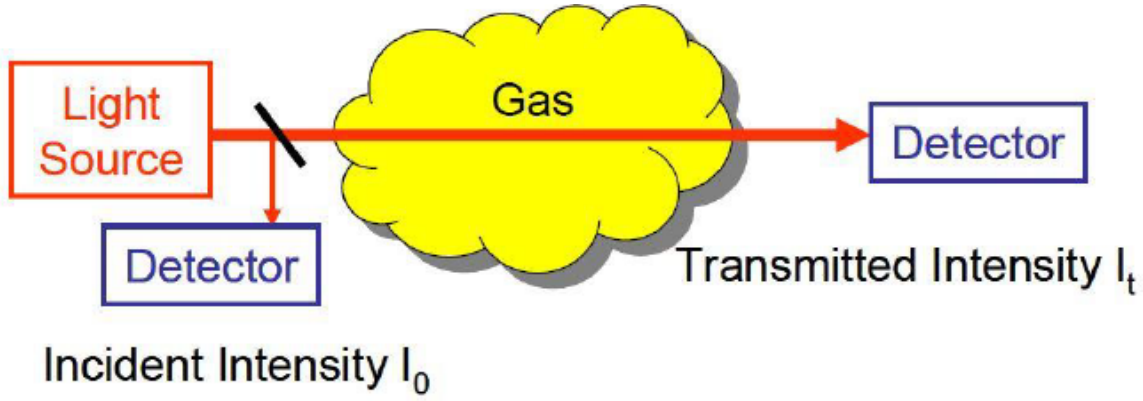
Optical In-Situ CEMS

What is Optical In-Situ Monitoring Technology?

- What: Equipment consisting of a light source, calibration cell, incident and transmitted light detectors used to measure the amount of light absorbed by a pollutant or diluent at a specific wavelength
- How: Measures any element, compound or analyte by transmitting a specific wavelength of light
- Typically used to measure

  NO, NO_2, O_2, NH_3, CO, HCl etc.



How Do Optical In-Situ CEMS Measure Emissions?

- Cross-stack measurement as opposed to a sample extracted at a point (i.e. probe tip)
- Absorbance at a specific wavelength is proportional to path length and concentration for a given element, compound, or analyte
- Concentration is calculated using the Beer-Lambert law based on the measurement pathlength, transmitted intensity, incident intensity, absorption line strength and specific absorption of target element, compound, or analyte
- Account for temperature and pressure corrections as necessary

Optical In-Situ CEMS Certification

- Part 75 is performance-based and equipment neutral
- Under Part 75 optical in-situ CEMS must successfully perform the same certification tests and meet the same requirements as extractive CEMS
  - RATA
  - **Linearity Check**
  - **7-day drift check**
  - Cycle time test
  - DAHs verification

Part 75 Technical Q&A Question 1.3

- Question: Can I use an optical in-situ monitoring system for monitoring under Part 75? If so, how do I challenge the system with calibration gases and what procedure should I use to calculate the required gas tag values?
- Answer: Yes. An optical in-situ system may be used so long as it is approved under the Part 75 regulations via issuance of a monitoring system certification. This means the system must pass all required tests. To test the instrument linearity and calibration error, EPA Protocol gases must be used to test the instrument linearity and calibration error, which can include a calibration cell placed in the measurement path. The calibration cell must be located to challenge the entire measurement system. This is analogous to the injection of calibration gas to the probe tip of extractive systems.

Part 75 Technical Q&A Question 1.3

- Answer: When the calibration cell is in-line with the stack measurement, the actual monitoring system response used in Part 75, Appendix A, Section 7.2.1, Equation A-5 can be determined by subtracting the stack concentration from the system response during the calibration. The stack concentration is typically determined by averaging the system response, with nitrogen or zero air in the calibration cell, immediately before and after the calibration.
- The design should maintain the audit calibration gas at the same temperature and pressure as the stack gas being measured. Alternatively, the owner or operator could determine the calibration cell temperature and pressure and apply appropriate corrections to the audit measurements to represent monitor performance at actual effluent conditions.
- For more information, see EPA Part 75 Technical Q&A

Daily Calibrations and Linearity Checks for In-Situ Monitors

- Perform calibration, checking all active electronic and optical components, including the transmitter, receiver, and analyzer. (refer to Appendix A §6.3.1)
- **Depending upon the design of the calibration gas cell**, the equivalent audit value or actual tag value of the injected Part 75 calibration gas is determined based on:
  - The required reference gas concentration specified in Section 5.2 of Appendix A of Part 75 as a percentage of the calculated span value
  - Measurement pathlength to calibration pathlength ratio
  - Calibration cell temperature to measurement path temperature ratio
  - Measurement path pressure to calibration cell pressure ratio
  - Line strength factor

Tag Value vs. Target Value

Part 75 Technical Q&A 1.3

$$EAV = SAV \times \frac{MPL}{CCPL} \times \frac{CCT}{MPT} \times \frac{MPP}{CCP} \times \frac{1}{LSF}$$

Where:

EAV = Actual tag value of the EPA protocol gas to be injected

SAV = The required reference gas concentration specified in Section 5.2 of Appendix A of the rule as a percentage of the calculated span value.

MPL = Measurement Path Length

CCPL = Calibration Cell Path Length

MPT = Measurement Path Temperature

CCT = Calibration Cell Temperature

MPP = Measurement Path Pressure

CCP = Calibration Cell Pressure

LSF = Line Strength Factor

LSF is an instrument specific correction for temperature and gas matrix effects derived from the HITRAN and manufacturer specific database.

Considerations for In-Situ Technology

- Measurement path length versus calibration cell path length
- Calibration gas bottle concentrations particularly for high range or high-level diluent gas
- Ambient temperatures can impact calibration gas temperatures

Considerations for In-situ Technology

- NO calibrations? NO_2 calibrations?
- The owner or operator shall account for both NO and NO_2 emissions to get total NO_X either by monitoring for both NO and NO_2 or by monitoring for NO only and adjusting the emissions data to account for NO_2 (refer to 75.10(a)(2))
- Reporting calibrations

Documenting QA Procedures

- Keep a written record of the procedures used for daily calibration error tests and linearity checks
  - How gases are to be injected
  - Adjustments of flow rates and pressure
  - Introduction of reference values
  - Length of time for injection of calibration gases, steps for obtaining calibration error or error in linearity
  - Determination of interferences
  - When calibration adjustments should be made

Documenting QA Procedures

- Identify any calibration error test and linearity check procedures specific to the continuous emission monitoring system that vary from the procedures in appendix A to Part 75. (refer to Appendix B §1.2.1)
  - How is the calibration cycle conducted (i.e. time interval to purge, flood calibration cell, record, repeat etc.)?
  - How are stack concentrations accounted for? (if applicable)
  - NO_2?

Questions?