GASEOUS CEMS CALIBRATION

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JULY 2022

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CALIBRATIONS

- Daily calibrations of all monitors are required for on-going quality assurance
- The tests must be conducted while the unit is combusting fuel, unless a successful offline calibration demonstration has been conducted
- Offline calibrations may be used to validate data on a limited basis (up to 26 consecutive operating hours at a time)
  - Typically, are used for combustion turbines that start up and shut down frequently
- Gas monitors are calibrated using cylinder gases of known concentration
- Flow monitors are generally calibrated with electronic input signals

CALIBRATION ERROR AND CALIBRATION DRIFT

- Calibration Error (CE) is the difference between the concentration indicated by the CEMS and known concentration generated by a calibration source when the entire CEMS is challenged; CE test is performed to document the accuracy and linearity of the CEMS over the entire measurement range.
- Calibration drift (CD) is the difference in the CEMS output readings from the established reference value after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

CALIBRATION EQUIPMENT

- Cylinders are located remotely
- High quality non-reactive materials are used for transport of sample and calibration gases
- Stainless steel, or non-reactive material used for calibration gas regulator
- Gases must be certified under EPA Protocol Gas Verification Program

CALIBRATION GASES

- All calibration gases except for "zero gas" must have NIST traceability
- Protocol Gas Verification Program (PGVP)
- EPA Protocol Gases must be obtained from a gas manufacturer participating in the PGVP (see § 75.21(g))
- EPA maintains a list of gas manufacturers participating in the PGVP on its web site
- Protocol gases must be prepared according to EPA document 600/R-12/531, May 2012, "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards"
- Gas vendors are subject to periodic blind audits and results are posted to EPA's web site
  - https://www.epa.gov/airmarkets/protocol-gas-verification-program-pgvp

CALIBRATION GASES

- Calibration gases can, and often are combined “blended” with compatible constituents (non-reactive).
- Calibration blended gases are analyzed and certified according to PGVP.
- This technique allows for multiple calibrations while flowing gas from a single cylinder.

CALIBRATION GASES

- Calibration gases are delivered through the entire system to the sample probe.
- It is important that the calibration gases are delivered at a similar pressure and rate to that of the system sample rate.
- Over/under pressurization can adversely effect calibration results.
- Clean and dry calibration tubing minimizes potential bias of the system. Especially when calibrating with reactive gases such as SO_2.

DAILY CALIBRATION SPECIFICATION

- Daily calibration using a zero gas and either a mid or high calibration gas
- Calibration error cannot exceed 5.0% of the span value, or 1.0% CO_2 or O_2
  - If calibration error gets to 2.5%, or 0.5% CO_2 or O_2 this is a maintenance limit.
- Alternatively, if the span value for NO_x and SO_2 is ≤50 ppm and the result does not exceed 5.0 ppm, or 10 ppm for spans >50 and ≤200 ppm
- If the daily calibration does not meet these criteria, then the system is considered "out-of-control".
- Flow monitoring systems cannot exceed 6% of the span value, or 0.02 inches of water column.

CALIBRATION PROCESS

- Calibrations are conducted in a “hands off” manner.
  - Meaning no adjustments are made to the system during the calibration period.
- Calibrations are conducted within eight hours of the unit start up.
- Calibrations are controlled by the data acquisition and handling system (DAHS)
  - Datalogger is programmed with sequence programming to activate a calibration when certain conditions occur (e.g., unit start-up).
  - Datalogger can also be programmed to perform calibrations on a routine clock basis.
  - If the parameters are exceeded (criteria for passing) the datalogger will flag the data appropriately which provides and alarm for the parameter(s).

CALIBRATION PROCESS

- If the calibration fails, then the unit is considered out of control and maintenance is performed as soon as possible to minimize the invalid data period.
- Once corrective actions have been completed a "hands off" calibration must be performed to return to normal operation and have valid data.
  - In some cases where instrument repairs include the replacement of critical parts, or the sampling system (e.g., dilution orifice) certain QA procedures need to be performed (i.e., abbreviated (or diagnostic) linearity).

REPAIR OR REPLACEMENT

CALIBRATIONS ARE IMPORTANT

- Calibrations are not just a formality
- Calibrations are your most valued instrument to troubleshoot problems.
- If used properly you can predict trends in performance.
- Routine maintenance is essential.
- The problem could very subtle and difficult to locate, or It could be something could be far worse.
- The environment these systems operate in are hostile.
- Even calibration system components fail
  - Tubing ages
  - Regulator wetted surfaces corrode
  - Compression fittings leak, or cause leaks.
- Heated lines, pump heads, peristaltic tubing.

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THANK YOU FOR LISTENING

ANY QUESTIONS?

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