



Custom Instrumentation Services Corporation

2018 USERS GROUP PRESENTATION:
Calibration Checks

Calibration Topics

- **Basics of Calibration Checks:**

- Validate Analyzer Data per 24 hour cycle

- Sequencing Calibration Gases

- Nitrogen Versus Oxygen Zero Gas

- Part 60 Versus Part 75 Regulations

- Other Regulations may apply, but not discussed here
(PADEP, SQAQMD, CANADIAN)

- Part 60 Warning Terminology

- Online Versus Offline Calibration Checks

Validation of Data

- An Analyzer's response to the gas it is designed to measure is an electronic signal. Calibration Gas provides reference points for the detector output, and allows us to give assign the output concentration values in terms of ppm or %.
- The accuracy of an analyzer's output signal is entirely attributed to the concept that the Calibration Gas Concentration value is certified.
- Daily Calibration Checks are required to verify that the analyzer is providing certified values as per the QAQC.
- Therefore, the method of delivering, timing and sequencing of the calibration gases is one of the most important aspects of an automated CEMS.

Calibration Gas Sequence

- **Sequencing is not regulated, based on best practice**
 - Zero is usually first.
 - Normal Emissions rates are low, close to zero, so purging out the process pollutant concentrations will happen quickly
 - Can use Nitrogen or Oxygen, this choice is discussed later
 - Low Analyzer Range Spans for NO_x , CO, SO_2 . The jump from zero is significant, so do the low range spans first
 - High Analyzer Range Spans for NO_x , CO, SO_2 .
 - Oxygen Span: When not using O_2 for the zero gas, run the Oxygen as the last gas since this will flush out the high concentrations of Span gas from the previous span check.
 - If ending the calibration sequence using a High Range Span gas, be sure to supply enough end-of- calibration purge time to flush out the high concentrations

Cal Gas Selection

- **Use O₂ for Zero gas or Nitrogen?**
 - Nitrogen is very cheap and provides excellent zero capability
 - CEMS Zero Nitrogen is readily stocked by suppliers and so can be delivered quickly
 - Oxygen performs dual purpose of providing a zero for Non-oxygen analyzers, and spanning the Oxygen analyzer. This decreases the Calibration Check Duration.
- **Use Instrument Air for O₂ Span or Cal Cylinder?**
 - Part 75 Policy Manual has clarified that Instrument Air may be used for as the high gas for Daily Calibration Checks and Linearity Checks.
 - They do require that the air be free from contaminants, how can this be proven?
 - Because using both Nitrogen Zero and O₂ Span extends the total calibration time, (refer to O₂ Zero gas above), this might cause invalid hour data under some circumstances or if multiple calibrations are run in an hour.

Calibration Timing Settings

- Standard settings for CiSCO systems:
 - 4 minutes of Purge Time for each Gas. Purging is performed with the calibration gas that is used to challenge the analyzer.
 - Purge Times are User Settings in the OIT panel or Realview.
 - Setting Purge times lower, saves gas, but raises possibilities of unstable results, especially during times of high emissions; startup, shutdown, process variations.
 - 1 Minute of Sample Time for Each Gas. Once the purge time is completed, the CEMS Data system begins averaging data for a period of one minute, the end result, being the calibration check response. (Some sites have 30 second or less Sample Times)
 - Sample Time is not changeable.
 - End-of-Cal Purge Time. Once the last Cal result is calculated, the last calibration gas is shutoff, and process gas begins to enter the system. The End Of Cal purge time should be set long enough to allow the process gas to travel to the analyzer, and the analyzer stabilize on the process values.
 - Typically set to 2 minutes, this is a user changeable setting.

Regulations Related to Calibration Checks

- **40 CFR Part 60, Part 75**

- Both Regulations are applicable to most Gas Turbine Power Producers
- There are multiple regulations regarding the Quality Assurance standards of gas analyzers. For Part 60 and Part 75 their respective Appendix B sections describe the requirements for Calibration Check Tolerances
- Because the limits are somewhat different, CiSCO reports show the tolerance level for each regulation, and are labeled accordingly.
- CiSCO Software also evaluates the calibration result based on both regulations and will flag a Calibration Check fail as either per Part 60, Part 75 or both, as appropriate.

Regulations Related to Calibration Checks Continued

- **Performance Specifications:**
 - These are the minimum Calibration Check Tolerances for Calibration Accuracy. An analyzer must only meet the Performance Specification at initial Certification during the 7-Day Drift Test.
 - Performance Specifications are written for each Type of gas Measurement, and so NO_x, CO and O₂ have different specifications.
- **Twice the Performance Specification:**
 - Part 60 provides a warning drift limit for Daily Calibration Checks which is equal to the Performance Specification x 2 (see Chart)
 - Part 60 Goes on to say that if the analyzer were to exceed the warning limit for 5 consecutive days, the analyzer data would then be flagged as **Out of Control and analyzer data is invalidated** going forward. Data should be **invalidated** retroactively for the entire period starting with the first warning limit exceedance.
 - Part 75 does not provide a warning limit, instead 2 x the Part 75 Performance Specification results in an **Out of Control Fail and analyzer data is invalidated**.
- **Four Times the Performance Specification:**
 - Part 60 Regulations require that an analyzer is Out of Control if it fails to meet the tolerance limit equal to 4 x the Performance Specification. **Data is Invalidated**.

Cal Fail Terminology

- **Twice the Performance Specification for Part 60:**
 - The Part 60 warning drift exceedance has been flagged in CISCO Calibration Reports as “Cal Fail Above” or “Cal Fail Below”. Recently this has been changed in CeDAR 5 to “Cal Drift Warning”
 - Labeling it as “Cal Fail Above/Below” Caused some confusion/dissatisfaction among our customers as it implies the analyzer data must be invalidated, even though it is not invalidated. We claimed that the use of the word ‘Fail’ was better since it prompted a stronger response to correct the issue. It is our belief that that analyzer should never exceed 2 x the performance specification unless a serious problem exists.
 - Calibration Check results that result in “Out of Control” Status causes analyzer data to be invalidated. Data will remain invalid until a passing calibration check occurs.
 - Part 75 States that for dual range analyzers where only one of the two ranges fails calibration, the result will be that both ranges will be flagged as Out of Control. Part 60 does not specify how to handle this case, but we adopted the Part 75 Rule as our standard.

Calibration Check Tolerance Limits

	Part 60 Limits			Part 75 Limits
	Performance Spec/ 7- Day Drift Limit	Daily Warning Limit (X2) **	Daily Out of Control Fail (X4)	Fail
NO_x, SO₂ *	2.5% / Part 60 5 ppm/Part 75	5.00%	10.00%	5 ppm or 5% of span (Span ≤ 50 ppm). 10 ppm or 5% of span (Span > 50 ppm).
CO *	5.00%	10.00%	20.00%	N/A
O₂ Limit in %	0.50%	1.00%	2.00%	1.00%

* NO_x CFR Part 60 Limits are based upon percentage for the Analyzer Range, while CFR Part 75 Limits are based upon Analyzer Span (not always the same).

** Five consecutive daily warnings results in an out-of-control fail.

Regulations Related to Calibration Checks Continued

- **Does Process Online / Offline Status Affect Calibration Checks?**
 - If a process is down, a calibration check is not required. There are areas that are an exception.
 - If a Process goes online at a time when the analyzer has not performed a successful calibration check in 24 hours, the system will create a “No Calibration in 24 Hours” Alarm.
 - Part 60 does not specifically say what happens if the 24-hour clock for a valid calibration check is exceeded, so we only invalidate data based on Part 75 Rules.

Regulations Related to Calibration Checks Continued

- **Does Process Online / Offline Status Affect Calibration Checks?**
 - Part 75 has a few scenarios for how to deal with a missing calibration:
 - If the site has been down for an extended period, greater than 1 hour, and has not performed a valid Calibration Check in 24-hours, then it is given an 8-hour grace period before data is invalidated.
 - If the site has only been down for a brief trip, less than 1 hour, then the grace period is only 2-hours beyond the 24-hour period since the last valid cal.
 - Part 75 requires Online Calibrations for Validating data. However, the site may conduct an Online/Offline comparison test. If difference between and online/offline calibration are within the allowed tolerances, then data may be validated during Off-line calibrations. It is standard for CISCO to include this test during certification for our sites.
 - If an analyzer Fails a calibration check due to a non-system, non-analyzer problem, such as a Power Outage, Incorrect Calibration Reference value, or Other human error, data should not be invalidated due to the fail, however, the condition for a valid calibration has not been met, So the site is still on the standard calibration clock, which might result in a 2 or 8 hour grace period to perform a valid calibration. The CEMS Data system will not understand the conditions, and so will flag data as invalid at the time of the calibration fail, it Is up to the user to edit the monitoring code to validate data in this case.
 - CISO recommends performing calibration checks everyday unless an extended downtime is expected.

Questions?

- Thanks –

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