Maintaining Continuous Emissions Monitoring Systems To Achieve High Reliability

a technical solution to meet every need...

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CONTINUOUS EMISSION MONITORING

Gas Fired, Coal Fired, Waste to Energy & Process Applications

Fully Extractive or Dilution Extractive
KNOW YOUR SYSTEM!!

- What regulations does your facility fall under?
- Who is the local regulatory agency responsible for your facility?
- What type of CEM System do you have? Fully extractive or dilution?
- Who are the manufacturer’s of the major parts of the CEMS System? Probe, cooler, analyzers, DAHS.
CEMS TYPES

- FULLY EXTRACTIVE (DRY BASIS)
- DILUTION EXTRACTIVE (WET BASIS)
- OTHERS:
  - FULLY EXTRACTIVE (HOT/WET)
  - IN-SITU (CROSS STACK or PROBE)
  - EX-SITU (CLOSE COUPLED EXTRACTIVE)
FULLY EXTRACTIVE - Dry Basis

- Sample Gas Dried To A Dew-point Of +2°C
- Excellent Performance In Low Concentrations
- Good Performance In High Concentrations
- Requires Preventative Maintenance
- **MEASUREMENT TYPES:** Chemiluminescence, NDIR, UV Absorption, UV Fluorescence, Paramagnetic, Zirconia, FTIR, DOAS, IR-GFC
- Heated Probe Filter And Heated Sample Line
- Moisture Volume Needs to be Determined – Constant or Measured
SAMPLE CONDITIONING BAY
SAMPLE PROBE WITH HEATED FILTER
DILUTION EXTRACTIVE - Wet Basis

- Dilutes sample with clean dry air
- Minimizes maintenance
- Uses highly sensitive gas analyzers
- Lower cost sample line – freeze protected
- Simple to operate
- Measurement types: Chemiluminescence (NOx), UV fluorescence (SO2), GFC-IR (CO), NDIR (CO2 diluent)
DILUTION CONTROL PANEL

GAS ANALYZERS
Application Choices – Dilution or Extractive

- Pollutant Concentrations
  - Lowest constituent dictates
  - May preclude dilution due to analyzer limitations

- Mass Emissions Requirement
  - Dilution is a wet basis measurement
  - Requires flow measurement
<table>
<thead>
<tr>
<th>APPLICATION CHOICES</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Dilution Extractive| Low maintenance  
                     More reliable  
                     Coal fired  
                     Some oil fired | Low concentrations  
(Ratios above 100:1) |
| Fully Extractive   | Low concentrations  
                     Gas fired  
                     Some oil fired  
                     Fuel flow meter | Higher maintenance  
Lower availability |
MY CEM SYSTEM IS INSTALLED. NOW WHAT?

- Time to learn about your CEMS.
  - Training: Most integrators can provide training that covers equipment from many different manufacturers.
  - Inventory: Set up a spare parts inventory with consumable and critical spare parts.
- Get your hands dirty.
  - Perform maintenance checks according to the Quality Assurance/Quality Control Plan.
  - Have CEMTEK’s phone number on speed dial.
QUALITY ASSURANCE/QUALITY CONTROL PLAN

- Why do I need to follow the QA/QC Plan?
  - It’s the LAW!!!
  - A record of CEMS maintenance proves to the regulatory agency that the data is quality assured.
  - The QA/QC plan is a guideline to develop your own maintenance schedule.
### DAILY PREVENTATIVE MAINTENANCE

**Sample System Checks – Daily**

<table>
<thead>
<tr>
<th>Item</th>
<th>Tag</th>
<th>Set Point</th>
<th>Record Daily Value or Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument air</td>
<td>PG1</td>
<td>&gt;90 psig</td>
<td></td>
</tr>
<tr>
<td>Sample pressure</td>
<td>PG2</td>
<td>&gt;2 psig</td>
<td></td>
</tr>
<tr>
<td>Probe vacuum</td>
<td>VG1</td>
<td>&lt;10 inch Hg</td>
<td></td>
</tr>
<tr>
<td>Sample probe purge air</td>
<td>FR1</td>
<td>&gt;80 psig</td>
<td></td>
</tr>
<tr>
<td><strong>Flows</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total sample flow</td>
<td>RM1</td>
<td>4-5 lpm</td>
<td></td>
</tr>
<tr>
<td>NO\textsubscript{X} analyzer flow</td>
<td>RM2</td>
<td>~1.5 lpm</td>
<td></td>
</tr>
<tr>
<td>CO analyzer flow</td>
<td>RM3</td>
<td>~1.5 lpm</td>
<td></td>
</tr>
<tr>
<td>O\textsubscript{2} analyzer flow</td>
<td>RM4</td>
<td>~1.5 lpm</td>
<td></td>
</tr>
<tr>
<td>Gas sample total flow</td>
<td>RM5</td>
<td>4-5 lpm</td>
<td></td>
</tr>
<tr>
<td><strong>Visual checks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room/enclosure temperature</td>
<td>HVAC</td>
<td>75°F, ±5°F</td>
<td></td>
</tr>
<tr>
<td>Moisture sensor/filter</td>
<td>MS1</td>
<td>Clean and dry</td>
<td></td>
</tr>
<tr>
<td>Cooler temp</td>
<td>GC1</td>
<td>Green light = okay</td>
<td></td>
</tr>
<tr>
<td>Drain pump</td>
<td>DP1  and DP2</td>
<td>Turning approx. 6 rpm</td>
<td></td>
</tr>
<tr>
<td>Sample line temp control</td>
<td>TC1</td>
<td>250°F, ±10°F</td>
<td></td>
</tr>
</tbody>
</table>
# WEEKLY PREVENTATIVE MAINTENANCE

## Sample System Checks – Weekly

<table>
<thead>
<tr>
<th>Item</th>
<th>Value or Status (Completed, OK, Replaced)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform all daily checks.</td>
<td></td>
</tr>
<tr>
<td>Perform manual calibration check.</td>
<td></td>
</tr>
<tr>
<td>Check moisture sensor (<strong>MS1</strong>) and tubing downstream of sample</td>
<td></td>
</tr>
<tr>
<td>conditioner for moisture. Remove and dry as necessary. Check sample</td>
<td></td>
</tr>
<tr>
<td>conditioner (<strong>GC1</strong>) for proper operation.</td>
<td></td>
</tr>
<tr>
<td>Verify sample line heater operation by checking current with amp</td>
<td></td>
</tr>
<tr>
<td>meter.</td>
<td></td>
</tr>
</tbody>
</table>

## DAHS Checks – Weekly

<table>
<thead>
<tr>
<th>Item</th>
<th>Value or Status (Completed, OK, Replaced)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check/change backup media (CD disk, tape, etc).</td>
<td></td>
</tr>
<tr>
<td>If enabled, verify that automatic backups have occurred for the week.</td>
<td></td>
</tr>
<tr>
<td>Verify there is sufficient disk for another week of data.</td>
<td></td>
</tr>
</tbody>
</table>
## MONTHLY PREVENTATIVE MAINTENANCE

<table>
<thead>
<tr>
<th>Sample System Checks – Monthly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
</tr>
<tr>
<td>Perform all daily and weekly checks.</td>
</tr>
<tr>
<td>Check sample pump (<strong>SP1</strong>); replace diaphragms and disks as needed, usually every 4 months.</td>
</tr>
<tr>
<td>Check peristaltic pump tubing (<strong>DP1</strong> and <strong>DP2</strong>), replace as necessary.</td>
</tr>
<tr>
<td>Change desiccant media (<strong>DH1</strong> and <strong>DH2</strong>).</td>
</tr>
<tr>
<td>If equipped with an air compressor:</td>
</tr>
<tr>
<td>1. Check/change oil as needed.</td>
</tr>
<tr>
<td>2. Check for excessive water build-up</td>
</tr>
<tr>
<td>Check filter on shelter HVAC system. Clean or replace as needed, usually every 2-3 months.</td>
</tr>
<tr>
<td>Check CGA/linearity cal gas bottle pressures &gt; 500 psig. Order new gas bottles as needed keeping in mind the lead time may be several weeks.</td>
</tr>
</tbody>
</table>

**CGA/Linearity Gas Cylinders**
### QUARTERLY PREVENTATIVE MAINTENANCE

#### Sample System Checks – Quarterly

<table>
<thead>
<tr>
<th>Item</th>
<th>Value or Status (Completed, OK, Replaced)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform all daily, weekly, and monthly checks. Note that all routine maintenance is to be performed prior to the required quarterly audit test.</td>
<td></td>
</tr>
<tr>
<td>If sample gas pressure (PG2) shows a decline, perform probe maintenance. Replace the filter element and clean the filter chamber as necessary. Replace O-rings. Verify probe box heater is operating.</td>
<td></td>
</tr>
<tr>
<td>If flow is low, check sample pump (SP1).</td>
<td></td>
</tr>
<tr>
<td>Verify and calibrate all CEMS alarm switches.</td>
<td></td>
</tr>
<tr>
<td>The rear motor on the drain pumps (DP1/DP2) should be given two drops of #20 non-detergent oil. Do not over oil. Clean off any dust or dirt.</td>
<td></td>
</tr>
<tr>
<td>Perform CEMS sample system leak check and flow balance procedure.</td>
<td></td>
</tr>
<tr>
<td>Check ammonia scrubber (AS1). When deposits are visible 75% of the way up the length of the scrubber, scrubbing media needs to be replaced. Depending on concentration of NH₃ and flowrate, media life may last 30,000 hrs.</td>
<td></td>
</tr>
<tr>
<td>Perform general housekeeping duties inside shelter/cabinet. Dust/clean all equipment surfaces.</td>
<td></td>
</tr>
</tbody>
</table>

#### QA Audits – Quarterly

| Perform quarterly CGA/linearity test and check DAHS results.          | Completed On: |
| Perform quarterly opacity calibration error test and check DAHS reports. | Completed On: |
| For Part 75 reporting systems: Perform quarterly stack flow-to-load analysis (done through the DAHS at end of reporting quarter). | Completed On: |
### ANNUAL PREVENTATIVE MAINTENANCE

#### Sample System Checks – Annual

<table>
<thead>
<tr>
<th>Item</th>
<th>Value or Status (Completed, OK, Replaced)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform all daily, weekly, monthly, quarterly, and semiannual checks. Note that all routine maintenance is to be performed prior to the required annual RATA.</td>
<td></td>
</tr>
<tr>
<td>Replace sample pump (SP1) diaphragms.</td>
<td></td>
</tr>
<tr>
<td>Inspect and clean thermoelectric cooler fan (GC1).</td>
<td></td>
</tr>
<tr>
<td>Inspect and replace as needed Fluororubber, polypropylene, PVC, toalone, and Teflon joints.</td>
<td></td>
</tr>
</tbody>
</table>

#### QA Audits – Annual

<table>
<thead>
<tr>
<th>Item</th>
<th>Value or Status (Completed, OK, Replaced)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform any required annual RATA.</td>
<td>All testing completed on:</td>
</tr>
<tr>
<td>Check results for the RATA Bias Adjustment Factor and enter the BAF into the DAHS record field.</td>
<td></td>
</tr>
<tr>
<td>For Appendix D reporting units: Perform annual fuel flowmeter accuracy check before close of the quarter in which due.</td>
<td>Analysis completed on:</td>
</tr>
</tbody>
</table>
WHAT HAPPENS IF I HAVE A FAILURE?

- Diagnose the problem
  - Check with your CEMS technician or CEMS vendor. Experience with the system can help answer questions.

- Repair the problem
  - CEMS require a minimum of 95% availability. Downtime can lead to data substitution or even worse, FINES!!

- Know the next step
  - Are recertification or diagnostic tests required?
# 40CFR PART 75 DIAGNOSTIC TESTS & RE-CERTIFICATION EVENTS

<table>
<thead>
<tr>
<th>Description of Event</th>
<th>Event Status</th>
<th>RATA</th>
<th>7 Day Error</th>
<th>Cycle Time Test</th>
<th>Linearity Check</th>
<th>Calibration Error Test</th>
<th>Submit RT556</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanently replace NO$_x$, SO$_2$, O$_2$ or CO$_2$ analyzer with like-kind analyzer as defined in Acid Rain Program Policy Manual Question 7.22.</td>
<td>R</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Permanent replacement of an analyzer is a recertification event. EPA does not require the cycle time test in this case, since the analyzer is like-kind and the rest of the system is the same. Modify RTs 510 and 530 in monitoring plan as necessary.</td>
</tr>
<tr>
<td>Permanently replace NO$_x$, SO$_2$, O$_2$ or CO$_2$ analyzer with new analyzer that does not qualify as a like-kind analyzer.</td>
<td>R</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Modify RTs 510 and 530 in monitoring plan as necessary.</td>
</tr>
</tbody>
</table>
Recertification and Diagnostic Test Policy for Dry-Extractive CEMS¹

<table>
<thead>
<tr>
<th>Description of Event</th>
<th>Event Status</th>
<th>RATA</th>
<th>7 Day Error</th>
<th>Cycle Time Test</th>
<th>Linearity Check</th>
<th>Calibration Error Test</th>
<th>Submit RT556</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace or repair any of the following components:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photomultiplier</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td>EPA will conditionally allow the abbreviated linearity check and the alternative response check (footnotes 5 and 6).</td>
</tr>
<tr>
<td>Lamp</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal analyzer particulate filter</td>
<td>D</td>
<td></td>
<td>6</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyzer vacuum pump</td>
<td>D</td>
<td></td>
<td>6</td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capillary tube</td>
<td>D</td>
<td></td>
<td>6</td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ozone generator</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaction chamber</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOX Converter</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ozonator dryer</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample cell</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical filters</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace or repair circuit board</td>
<td>D</td>
<td></td>
<td>5</td>
<td>X</td>
<td>A</td>
<td></td>
<td></td>
<td>EPA will conditionally allow the abbreviated linearity check.</td>
</tr>
</tbody>
</table>
WHAT DOES ALL OF THIS BOIL DOWN TO?

- CEMS reliability begins in the Engineering and Design phase.
- Perform regular Preventative Maintenance
- It’s All About Relationships
  - Develop a Relationship with your CEMS Vendor
    - Spare Parts Supplier
    - Service Contracts
  - Develop a Relationship with your Regulatory Agency
  - Develop a Relationship with your CEMS
A Technical Solution To Meet Every Need

- CEMS
- Process Monitors
- SCR / SNCR
- Scrubber monitors
- Coal mill monitors
- System upgrades
- Testing
- Quarterly Audits
- RATA
- Data Acquisition Systems
- Part 60
- Part 75
- State/Local reports
- Training
- QA/QC Plans
- Monitoring Plans

Thank You!