Combustion Gas Periodic Monitoring Protocol and Portable Analyzer Training and Certification

South Coast AQMD
Office of Compliance &
Enforcement

Welcome to…

Rule 1110.2, 1146, 1146.1

Portable Analyzer Training and Certification

Disclaimer

- Any of the products shown, depicted, or discussed in this presentation are for demonstration and instructional purposes only and should not be considered as South Coast AQMD endorsements for any particular product.
- There are several portable analyzer manufacturers. Please do your own research or use the internet to find a suitable manufacturer, distributor, or third party testing firm that can meet your portable analyzer needs.


NOVA
plus


LAND


testo

Introduction

- Rule 1110.2 Portable Analyzer Training for Internal Combustion Engines (ICEs)
  - Meets training and certification requirement specified in Rule 1110.2 (f)(1)(G)
  - Includes rule requirements and testing methods
  - Requires successful completion of certification exam at the conclusion of this presentation
  - Similar training required for boilers (Rule 1146 & 1146.1)

Overview

- Background
- 2008 Rule Amendments
  - Inspection/Maintenance Plan
    - **Periodic Testing Protocol**
    - **Recordkeeping/Reports**
    - **Training/Certification**

Rule 1110.2 Background

- Initially adopted in 08/90
- Applies to >50 HP ICEs fired by:
  - Natural gas
  - Oil field produced gases
  - Digester and landfill gases
  - Other fuels

2000 Portable Analyzer Pilot Study

- Goals
  - Determine feasibility of using portable analyzers for more frequent compliance determination between source tests
  - Develop a test protocol for compliance evaluation testing
  - Assess noncompliance rates and potential excess emissions of combustion sources (boilers & ICEs)

Pilot Study Test Results

Equipment	Applicable Rule	Units Tested	Non-Compliance Rate [3]	Excess NOx Emissions [4] (Potential TPY)	Excess CO Emissions [4] (Potential TPY)
Boilers [1]	1146	49	47%	21	4
	1146.1	27	81%	13	6
	1146.2	10	unknown	unknown	unknown
ICEs [2]	1110.2	23	71%	99	292
	Total	110	62%	133	302

1 Not including boilers that are permitted as part of a system, such as in oil/water/gas separation systems at an oil field site.
2 Stationary non-emergency ICEs.
3 Non-compliance rate from Pilot Study based on emissions >25% of rule or permit limit for NOx and/or CO per unit.
4 Based on test results as of 3.3.2004, assuming operation 24/7/365.

Potential Excess Emissions

Equipment	Applicable Rule	Total Population of Units [3]	NOx Non-Compliance Rate [4]	Excess NOx Emissions [5] (Potential TPY)	CO Non-Compliance Rate [4]	Excess CO Emissions [5] (Potential TPY)
Boilers [1]	1146	1,848	47%	792	6%	151
	1146.1	1,414	59%	681	22%	314
	1146.2	30,000	unknown	unknown	unknown	unknown
ICEs [2]	1110.2	1,211	54%	4,995	33%	14,734

[1] Not including boilers that are permitted as part of a system, such as in oil/water/gas separation systems at an oil field site.
[2] Stationary non-emergency ICEs.
[3] Information current as of 3.3.2004.
[4] Non-compliance rate from Pilot Study based on emissions >25% of rule or permit limit for NOx and/or CO per unit.
[5] Based on total population of units, compliance rates of NOx and CO individually for tested units, and average excess emissions calculated from test results, assuming operation 24/7/365.

Findings and Conclusions

- High rate of noncompliance from ICEs
- ICEs drift out of compliance, often within days of the last tune-up
- Emissions from non-compliant ICEs can be 10-1000 times over the permitted limit for nitrous oxides (NOx) and/or carbon monoxide (CO)
- ICE compliance status is not easily determined without a combustion analyzer or source test

Rule 1110.2 Amendments

- On February 1, 2008, Rule 1110.2 was amended to assure compliance with rule emission limits by requiring affected sources to:
  - Meet additional equipment requirements
  - Submit an I & M plan and source test protocol for South Coast AQMD approval
  - Conduct frequent emissions testing using a portable analyzer

Two Types of Engines

- Lean Burn Engines - Engines that operate with high levels of excess air and an exhaust oxygen concentration of greater than 4 percent
- Rich Burn Engines - Engines designed to operate near stoichiometric conditions with a catalytic control device that simultaneously reduces emissions of NOx and CO

Lean-Burn Engine Requirements

- Emissions
  - Engine Emissions Prior to Catalyst
    - Oxygen – Approximately 8.6%
    - NOx – Approximately 200 ppm uncorrected
  - Catalyst
    - Selective Reduction Catalyst
    - Ammonia Injection
    - NOx – Reduction 90-95%
    - CO – No Reduction

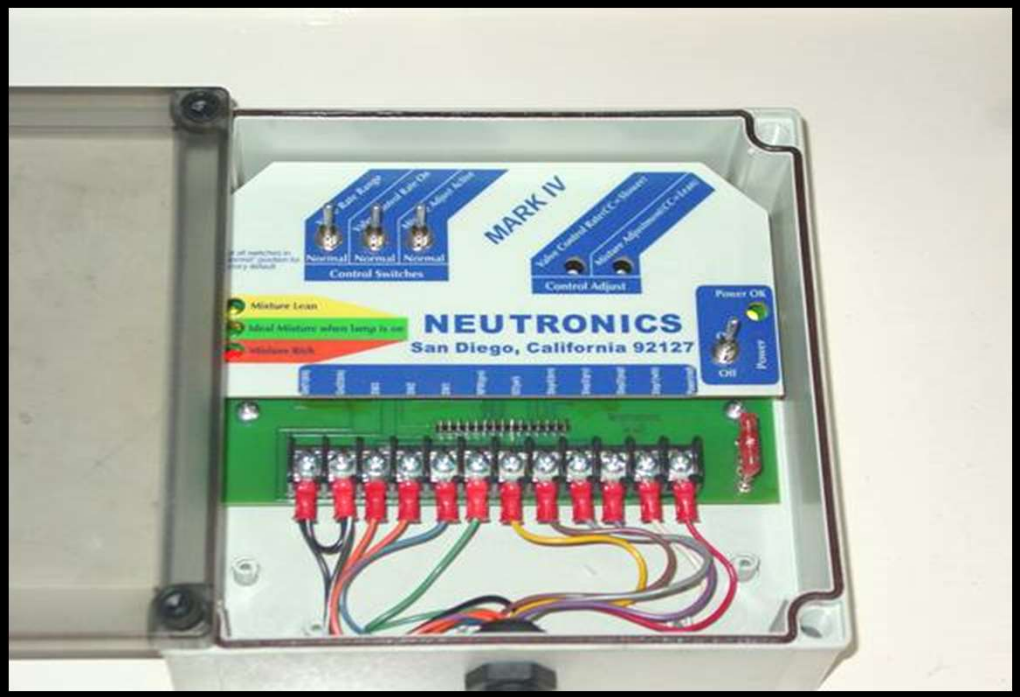
Rich-Burn Engine Requirements

- Air/Fuel Ratio Controller
- Non-Selective Catalyst
- Oxygen Sensor

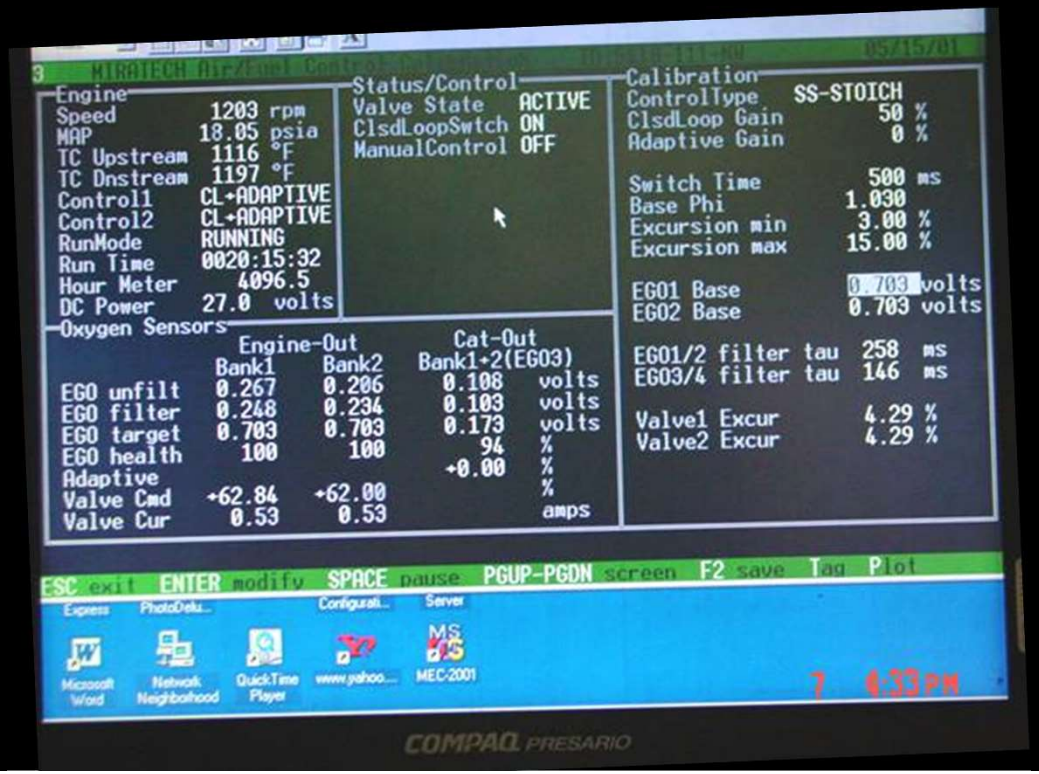
Air/Fuel Ratio Controller

- A computer or mechanical device that adjusts the ratio of air to fuel for ideal combustion
  - By 05/01/08 applications due for units with no air/fuel ratio controller
  - By 02/01/09 all ICEs without a CEMS shall install an air/fuel ratio controller with O_2 feedback sensor and control
  - See 1110.2 (d)(1)(K) and (e)(5)(A) for more details

Air/Fuel Ratio Controller



Air/Fuel Ratio Controller Display



Non-Selective Catalyst

- Engine Emissions Prior to Catalyst
  - NOx - 2,500 ppm uncorrected
  - CO - 3,500 ppm uncorrected
  - Oxygen - Less than 0.25%

- Catalyst – Non-Selective Reduction
  - First Reaction
    - $6CO + 3O_2 \Rightarrow 6CO_2 + 0O_2$
  - Second Reaction
    - $NOx + CO \Rightarrow N_2 + CO_2$

“Honeycomb” Type Catalyst Bed

Typical Destroyed Catalyst

More Destroyed Catalysts

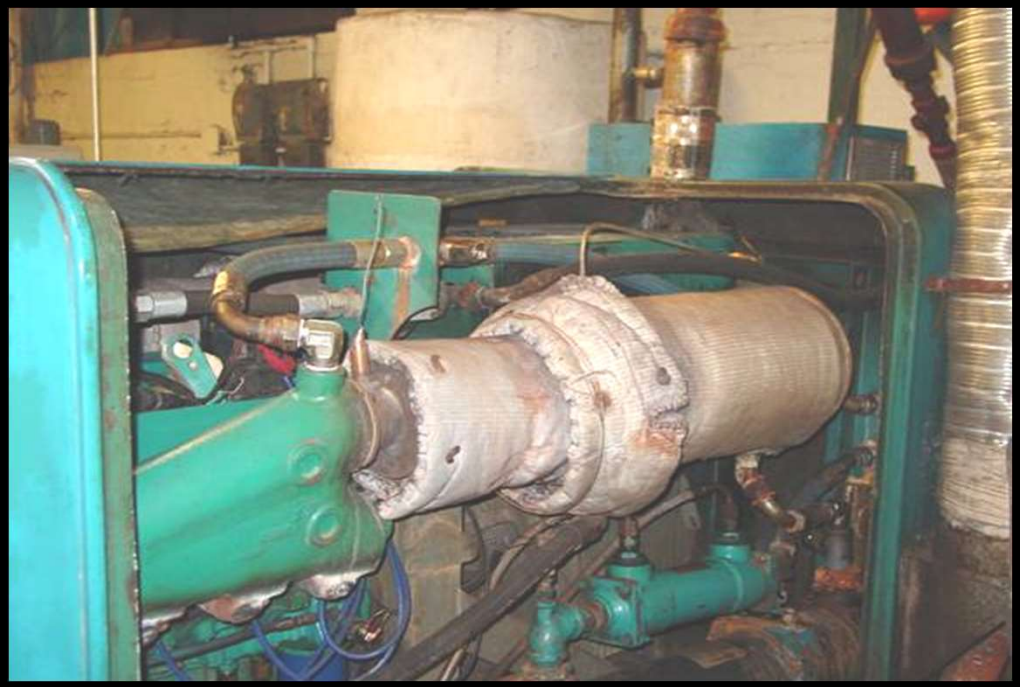
No Catalyst Installed

Missing Catalyst Section

Oxygen Sensor

- Electrochemical device which produces a voltage reading depending on the concentration of oxygen in the exhaust stream

Missing O_2 Sensor Wire



Emission limits for all natural gas fired ICEs without lower specified permit limits

Engine Rating	February 1, 2008			July 1, 2010			July 2, 2011		
	NOx ppm	VOC ppm	CO ppm*	NOx ppm	VOC ppm	CO ppm*	NOx ppm	VOC ppm	CO ppm*
<500 BHP	45	250	2000	45	250	2000	11	30	250
>500 BHP	36	250	2000	11	30	250	11	30	250

*Corrected to 15% O_2

July 1, 2010 emission limits do not apply to ICEs:

- Operated ≤ 500 hours/yr
- Using < 1 x 10^9 BTUs/yr based on fuel Higher Heating Value (HHV)

CEMS units required

- ICEs >1000 BHP and operating more than 2 MM BHP-hr annually
- Facilities with combined ICE BHP ratings > 1500 BHP with combined fuel usage greater than 16 X 10^9 BTUs annually
- May request alternative monitoring device equivalent to CEMS

Specialty Engines Not Covered in this Training & Certification Presentation

- ICEs with Continuous Emission Monitoring Systems (CEMS)
- ICEs subject to RECLAIM
- ICEs fired by digester and landfill gas
- Portable and stationary agriculture ICEs
- New electrical generation units
- Review Rule 1110.2 for specific requirements and additional exemptions

Inspection and Monitoring (I&M) Plans

Inspection and Monitoring (I&M) Plans Rule 1110.2 (e)(4)

- Submit I&M Plan to South Coast AQMD within six months of rule adoption date
  Feb 1 2008 + 6 months = **Aug 1, 2008**
- Implement an approved plan (or as submitted, if not yet approved) within 10 months of rule adoption date
  Feb 1 2008 + 10 months = **Dec 1, 2008**

Inspection and Monitoring (I&M) Plans
Rule 1110.2 (f)(1)(D)

- Submit plan and fees to AQMD for written approval & implement an I&M Plan
- One application for each facility site
- Identify each ICE and control equipment parameters (e.g., procedures, setpoints, temperatures, etc.) necessary to maintain ICE in compliance with NOx & CO permit limits

Inspection and Monitoring (I&M) Plans Rule 1110.2 (f)(1)(D)

- Weekly emission check (or every 150 ICE operating hours) using a portable analyzer
  - **No tuning/maintenance within 72 hours of test**
  - **Analyzer shall be calibrated, maintained and operated per South Coast AQMD's Combustion Gas Periodic Monitoring Protocol which can be found at the following site:**

http://www.aqmd.gov/rules/doc/1146&1146.1/FinalCombustionGasPeriodicMonitoringProtocol.pdf

Inspection and Monitoring (I&M) Plans Rule 1110.2 (f)(1)(D)

- Monitoring, inspection and recordkeeping
  - Responding to, diagnosing and correcting breakdowns, faults, etc.
  - Schedules for preventive/corrective maintenance
  - Reporting noncompliance
- Review Rule subpart for specific details

Inspection and Monitoring (I&M) Plans Rule 1110.2 (f)(1)(D)

- Submit procedures and format for recordkeeping of monitoring and other actions required by the plan
- Plan revisions
- ICEs with CEMS not subject to above subpart
  - Submit procedures for alerting operator to emission control malfunctions
    - All Air/Fuel Ratio Controllers (AFRC) require a malfunction light and audible alarm

Portable Analyzer Testing Requirements Rule 1110.2 (f)(1)(D)(iii)

Portable Analyzer Testing Requirements Rule 1110.2 (f)(1)(D)(iii)

- Testing required if no NOx and CO CEMS on ICE
- Tester must have South Coast AQMD-approved training and certification
- Tester must follow manufacturer specifications for proper use of analyzer.
  - ~~Analyzers are certified by US Environmental Protection Agency (EPA) Environmental Technology Verification Program (ETV)~~
  - ~~See EPA website: http://www.epa.gov/etv~~

Portable Analyzer Testing Requirements Rule 1110.2 (f)(1)(D)(iii)

- Monitor for NOx, CO, O_2 (15 minutes data min.)
- No ICE tuning or maintenance 72 hrs. prior to test
- Start with weekly testing (or every 150 operating hours)
- ICE may be tested monthly (or every 750 operating hours) if three consecutive weekly tests in compliance
  - No adjustment made to AFRC set points
- Must resume weekly testing
  - Any noncompliant tests
  - Replacement of catalyst or oxygen sensor

Portable Analyzer Testing Requirements Rule 1110.2 (f)(1)(D)(iii)

- Additional emission test is required within 24 hours if operator finds any operating parameter out-of-range

Portable Analyzer Emission Testing

Portable Analyzer Emission Testing

- The next few slides will cover the subjects you need to be aware of when using the portable analyzer.
- The success of this program depends on you following these procedures for accuracy and your safety.

South Coast AQMD Monitoring Protocol

- Developed for testing of ICEs limited to fuels using natural gas, propane, butane, gasoline, biogas, refinery gas and fuel oil
- Based on CTM-030 and ASTM D-6522, with some deviations
- Does not supersede or replace EPA methods or South Coast AQMD source test methods
- Protocol is subject to revision at any time

South Coast AQMD Monitoring Protocol

- This simplified monitoring protocol was developed with easier parameters than the very complex CTM-030/ASTM D-6522 requirements needed for a full source test.

- Our purpose was to give the operator a snapshot of the ICEs emissions without a costly source test.

South Coast AQMD Monitoring Protocol

- To determine NOx, CO, and O_2 concentrations from ICEs subject to South Coast AQMD Rule 1110.2
- Allows use of portable electrochemical (EC) analyzer for periodic monitoring of ICE emissions
- Not equivalent to a “source test”

Review of Emission Testing

- Use proper sampling ports
- Make sure testing port is safe
- Test at atmospheric conditions
- Maintain an adequate analyzer flow rate
- Minimize condensation/use heated line
- Use a sample gas conditioning system
- Be mindful of possible interferences
- Follow the protocol/take your time

Use proper sample ports

- Test in straight run of duct
  - Away from disturbances, such as bends, junctions, etc.
- Sampling point should be minimum of:
  - 2 stack diameters downstream of disturbance
  - ½ stack diameter upstream of disturbance
- Test after the catalyst housing
- Single point, center point testing okay
  - Unless previous data shows stratification (>10% difference in emission concentrations across stack)

Sample port issue

Sample port issue

Sample port issue

Safety

- Make sure the sample port location is in an area you can reach safely
- Exhaust stacks can be very hot
- Avoid confined spaces
- You may require a man-lift, scaffolding, or any other secure equipment to reach the test port

Safety issue

Testing considerations

- Minimize testing at high positive or negative stack pressures
- Locate sample ports for sampling at or near atmospheric conditions (low or zero static pressure)
- Maintain analyzer flow rate within manufacturer suggested range during testing and calibrations
  - May need additional flow gauges, rotometers, etc.

Minimize condensation: use heated line, if necessary

- Use shortest probe/sample line possible
- Try to keep sample line w/o loops or points where moisture can collect
- If you observe condensation, either insulate line or heat trace sample line, or use a condenser
- All sampling components shall be nonreactive to NO_2 gas (e.g., stainless steel, teflon, etc.)

Sample gas conditioning system

- Most analyzers have a thermo-electric chiller and/or chilled condenser system to remove moisture
- Ambient condenser may be used if NO_2 portion of NOx is <10%
- Moisture cannot be allowed to reach EC cells

Be mindful of interferences

- Analyzer must show 5% or less (of span) interference response to CO, NOx
- Use hydrogen compensated EC cells if possible
- Understand that high CO may influence NOx readings
- Consult w/analyzer manufacturer for site specific issues (other flue gas constituents)

Follow protocol/take your time

- Don’t hurry calibration or testing
- Don’t take shortcuts from protocol
- Allow zero calibrations to stabilize properly
- Allow proper warm up of instrument to ambient conditions

Measurement System: Performance Specifications & Apparatus

- Use any system that meets Sections 4 & 5 of CTM-030 and the South Coast AQMD's Combustion Gas Periodic Monitoring Protocol
- Maintain gas sample at conditions to prevent condensation
- NO_2 cell use is voluntary if NO_2 portion of NOx is <10% (Rich Burn Engines)

Measurement System: Performance Specifications & Apparatus

- Sensitivity
- Interference Response
- Moisture Removal System
- Electrochemical Cell Temperature
- Data Recorder
- Calibration Assembly
- Calibration Gas

Sensitivity

- Minimum detectable limits
  - 3% of range or 1 ppm - CO, NO, NO_2
  - 0.3% for oxygen (0_2)

Interference Response

- Analyzer CO, NO, NO_2 should be verified within 5% of span gas concentration
- No annual Interference Response Tests required for SOx
- Review other potential flue gas constituents for interferences

Moisture Removal System

- Use chilled condenser or thermo-electric cooler, most are internal for the analyzer
- Remove moisture continuously
- Ambient means is acceptable for gas streams with <10% NO_2

Electrochemical Cell (EC) Temperature Indicator

- Most of the portable analyzers on the market today use electrochemical (EC) cell technology. These are sensors and have no moving parts.
- EC temperature indicator:
  - Must monitor cell temperature
  - Must monitor at cell surface, within cell or in close proximity
  - Cannot be outside of manufacturer specifications or recommended operating range

Data Recorder

- Use procedures in 5.1.10 of CTM-030
- Strip chart, computer or digital recorder
- Minimum resolution
  - 1 ppm CO, NO, NO_2
  - 0.3% for O_2
  - 1 degree (C or F) for temperature
- Record a minimum of one data point every 15 seconds

Calibration Assembly

- Use 3-way tee, valve or equivalent
- Introduce gas at ambient pressure
- Designed so only calibration gas is processed
- Flow gas through all gas path filters

Calibration Gas

- For NO, NO_2 , CO Span, O_2 zero:
  - Use EPA Protocol gases (+/-2%)
  - Or NIST traceable
- For O_2 High Span, NO, NO_2 , CO zero:
  - Use ambient air (20.9% O_2, no pollutants)
- Select span gas within 100-150% of engine's emission concentration limit at actual stack conditions

Measurement System: Performance Check Procedures

- Needed to verify measurement system performance and accuracy
- For each set of field emission tests
  - Pre-test/post-test calibration check within 10 calendar days of each other
  - Linearity check, stability check, and CO interference check every 12 months or as necessary to ensure proper operation

Measurement System: Performance Check Procedures

I. Pre-test Calibration Check
   - Zero Calibration Check
   - Span Calibration Check

II. Post-test Calibration Check
   - Zero Calibration Check
   - Span Calibration Check

III. Linearity Check

IV. Stability Check

V. Interference Check

VI. Calculations

Calibration Overview

- Calibrations conducted to insure accurate data and that electrochemical cells are operating properly
- Frequent calibration is required in the South Coast AQMD's Combustion Gas Periodic Monitoring Protocol
- Data is only as good as instrument accuracy and calibration methods used

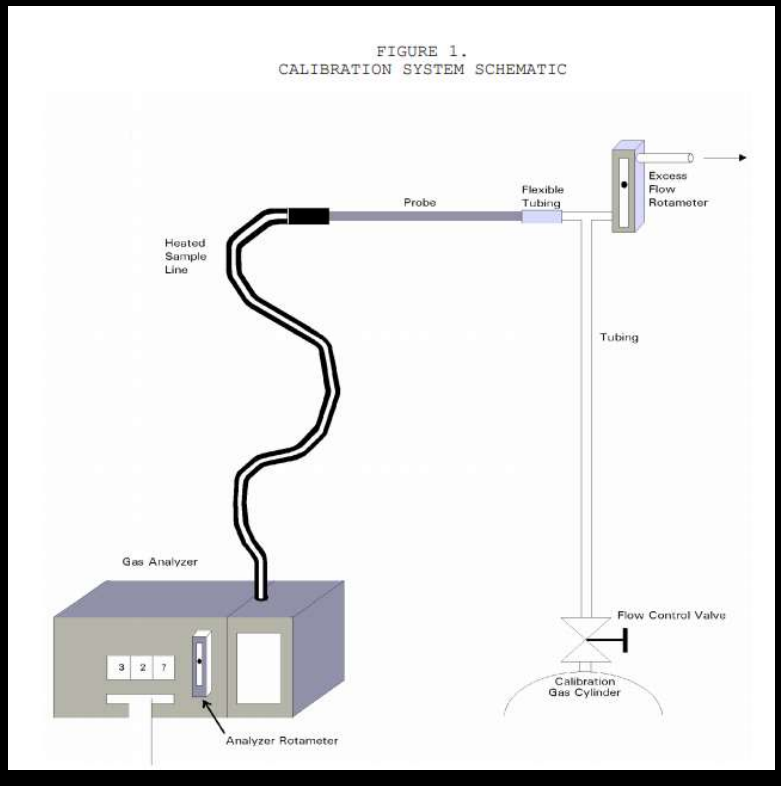
I. Pre-Test Calibration Check

- Choose appropriate CO, NO, NO_2, O_2 gases
- Introduce span gases to analyzer
- Constant flow rate (manufacturer recommendation)
- Acceptable error levels
  - CO, NO: +/- 5% span gas value
  - NO_2: +/- 10% span gas value
  - O_2: +/- 0.5% O_2 reading

I. Pre-Test Calibration Check

- Nitrogen - O_2
- Ambient air – NO, CO, NO_2
- 0-5% of sensor range
- Introduce zero gas to analyzer
- Calibration gas flow rate ~2 lpm
- NO, CO cell Drift +/- 3% span gas value
- O_2 Drift +/- 0.3% O_2 reading
- Follow Protocol (Section 3.1.1-2)

Calibration System Schematic



II. Post-Test Calibration Check

- Re-verification of accuracy of instrument, without adjustment
- Follow Pre-Test Error Check Procedure
- For data validity (usable for reporting)
  - No adjustments during post-test calibration check
  - Must be conducted within 10 days of pre-test and drift <5%

II. Post-Test Calibration Check

- Exception to 5% drift
  - 5%<Drift<10% and
  - Corrected emissions <75% of emission limit for unit
- Drift >5% and >75% of limit
  - Does not meet specs
  - Test data not valid
  - Recalibration and retesting required

Span Gases

- EPA Protocol 1,2 or NIST
- Certified minimum accuracy of 2%
- Typically 2 component - NO, CO in N_2
- 1 component - O_2 or NO_2 in N_2
- 100-150% of engine's emission concentration limit at actual stack conditions
- Maximum 2X source emission limit

Span Gases

- Allow EC to stabilize for 30 seconds once readings are +/- 5% of mean reading before recording result
- Do not adjust calibration until all calibrations are conducted and data is recorded

Selecting Span Gases

- Span gas must be between 100% and 150% of the engine's emission concentration limit at actual stack conditions
- Example:
  - 100% ≤ Y ≤ 150%
    - Y = a rich-burn engine with a 36 ppmvd NOx limit at 15% O_2, and operating at or near 0% O_2, would have a 127 ppmvd concentration limit at actual stack conditions.
    - CLactual = (36 ppmvd @ 15% O2) x (20.9-0.0/20.9-15.0) = 127 ppm
    - 127 ppm ≤ Y ≤ 190.5 ppm, use at least one gas in the 127-190.5 ppm range
    - See sample equation in section 2.7 of Periodic Monitoring Protocol

III. Linearity Check

- Select Mid Range Gas 40-60% of selected range
  - e.g. NO span range of 0-100 ppm
  - Mid range 40-60 ppm cal gas
- Determine if analyzer sensors react properly to various gas concentrations
- Determined from zero, mid, high data

III. Linearity Check

- Acceptable Criteria
  - **NO, CO, O_2: 3.0% of span gas value**
  - **NO_2: 3.0% of span gas value**

- O_2 Linearity Check is not required for an analyzer only testing rich burn engines with three-way catalysts

IV. Stability Check

- Choose appropriate gas for sensor
- Introduce gas at the probe tip
- Record data once per minute for 15 or 30 minutes
- Keep calibration gas flow rate constant ~2 lpm
- Review data - Is it acceptable?

IV. Stability Check
Analyzer Response Criteria

- Determine the NO, CO and if applicable, NO_2, response times to a step change. The longest time will be the analyzer response time
  - CO, NO
    - 95% response time
  - NO_2
    - 90% response time

IV. Stability Check
Analyzer Response Criteria

- Acceptable Results- Stability Test
- Difference between maximum and minimum recorded levels cannot exceed the following:
  - CO, NO, NO_2
    - +/- 2.5% gas value over 30 min
    - +/- 1% gas value over 15 min
  - O_2
    - +/- .5% O_2 over 30 minutes
    - +/- .25% O_2 over 15 minutes

V. Interference Check

- NO and NO_2 interference response of the CO cell
- Used to determine positive bias to CO cell
- Calculate using procedure in Section 3.5
- Conduct check
  - Annually
  - When cells are replaced

VI. Calculations

- Equations listed in Section 3.6
  - Calibration error (Ecal) for zero/span gases
  - Drift error of pre-test/post-test cal checks
  - Linearity (Elin)
- Use appropriate equations for each
- Follow equations precisely

Analyzer fails calibration check

- If error is outside acceptable range during calibration checks (pre-cal linearity, cal error,
  cal drift)
- If analyzer is not calibrated within 10 days
- If EC temperatures are outside of manufacturer specifications
- If analyzer calibration points are reset before post-test calibrations can be conducted
- Any deviation from protocol not approved by South Coast AQMD (calibration, testing, etc.)

Portable Analyzer Test Protocol Sample Collection — Section 4.3:

- Must follow Section 5.1.10 of CTM-030
- Sample time is minimum of 15 minutes (Plus 2x response time for analyzer)
- Use single point sampling if data shows not stratified (<10% diff. in readings)
- If stratified, use 3 point, single port test
  - Use 16.7%, 50%, 83.3% of stack diameter

Portable Analyzer Test Protocol Section 4.3: Sample Collection

- Assure system is leak free
- Zero analyzer with fresh air
- Record necessary parameters at start
  - Time, ambient temp, operating rate (load)
- Log all emission data every 15 seconds during testing
- Conduct post-test leak check after test

Recordkeeping Requirements Engines

- The facility and the tester will be required to keep records* of operating parameters, including:
  - a Measurement System Log
  - an ICE Operating Log
- Logs must be:
  - Kept on premises for at least 5 years
  - Made available upon request for each measurement system

*Electronically stored records OK if data can be retrieved at all times

Measurement System Log

- Linearity and Stability Forms (Form 1 & 4) must be completed/signed by trained personnel
- Calibration/Recordkeeping Form (Form 2) must be completed/signed by trained personnel
- Certificates of analysis for all gases listed on Forms 1, 2 & 4 must be available
- All maintenance/service records, including cell and filter replacement dates, purchases

Recordkeeping Requirements Boilers

- Measurement System Log
- Boiler Compliance Log
  - Periodic Monitoring Recordkeeping Form
  - Source Test reports

Recordkeeping Form 1

Linearity and Interference Tests

Recordkeeping Form 2

Calibration

Recordkeeping Form 3

Periodic Monitoring

Recordkeeping Form 4

Stability Check

ICE Compliance Log

- Periodic monitoring forms (Form 3) must be completed/signed by trained personnel
- Source test reports
- Inspection and Monitoring Plan records
- Operating Logs

Operating Log Requirements Rule 1110.2 (f)(1)(E)

- Maintain a monthly log including:
  - Total hours of operation
  - Type of liquid or gaseous fuel
  - Fuel consumption
  - Cumulative hours of operation since last source test
- Facilities subject to RECLAIM may maintain a quarterly log for process units only

Elapsed Time Meter
Rule 1110.2 (f)(1)(B)

- Maintain an operational non-resettable totalizing time meter to determine the ICE elapsed operating time

Non-resettable hour timer

Electronic Timer Meter

Rule 1110.2
Monitoring, Inspection & Recordkeeping

- Per 1110.2 (f)(1)(D) Plan:
  - Procedures for at least daily monitoring, inspection and recordkeeping must include:
    - ICE load or fuel flow rate
    - All set points, max and acceptable ranges of parameters identified in (f)(1)(D)(i) and actual values of same parameters
    - Elapsed timer meter operating hours
    - Operating hours since last emission check

Rule 1110.2 Recordkeeping

- Per 1110.2 (f)(1)(D)
  - For rich burn ICEs w/ 3-way catalysts:
    - Difference of inlet/outlet temperatures
  - ICE control system and AFRC faults or alarms affecting emissions
- Monitoring and recordkeeping may be done in person or by remote

Reporting Requirements Breakdowns/Exceedances

- Operator shall report to South Coast AQMD by phone (1.800.CUT.SMOG) any breakdown which results in excess emissions:
  - Within one hour of event (or reasonably should have known of event)
  - Include time, location, equipment, responsible party, contact info, any likely causes for exceedance, and repair time

Reporting Requirements
Breakdowns

- Within seven days & no later than 30 days of event submit a written report:
  - Equipment involved or causing breakdown
  - Duration of breakdown
  - Date of correction and demonstration of compliance
  - Identify excess emissions from breakdown
  - Quantify emissions and how calculated

Reporting Requirements Breakdowns

- Within seven days & no later than 30 days of event submit a written report:
  - Info whether breakdown was equipment or operator error, neglect, etc.
  - Steps taken to correct condition and minimize emissions
  - Describe corrective measures and how to avoid in future
  - Pictures of equipment which failed

Reporting Requirements
Rule 1110.2 (f)(1)

- If ICE or any control system operating parameter goes out of range or emission check finds excess emissions:
  - Shall report event to District (phone, email)
  - List same information as previous slide
  - See Rule for all requirements

Reporting Requirements
Rule 1110.2 (f)(1)(H)

- If testing determines emission exceedance
  - For breakdown call 1.800.CUT.SMOG
    - Within 1 hour of knowledge of event
    - Comply with 1110.2 (f)(1)(H)
  - Immediately correct exceedance or shut down ICE with 24 hours or end of cycle
- If testing determines emission exceedance at Title V Facility
  - Notify South Coast AQMD at 1.800.CUT.SMOG within 72 hours of knowledge of event and submit written report within 14 days
  - Use Form 500-N

Reporting Requirements
Rule 1110.2 (f)(1)(H)

- Submit to South Coast AQMD a quarterly engine status report within 15 days of each calendar quarter
  - See 1110.2 (f)(1)(H)(iii)
  - Submit report even if no emission exceedances were observed

Source Testing

- The next few slides will discuss new source testing requirements. These are not tests that you can run using the portable analyzer, and they would require a certified testing company to conduct them.

- Furthermore, these tests also measure VOC emissions which cannot be done using the portable analyzer.

Source Testing Instrumentation

Portable Analyzer

Source Test Methods - Flow

- Traverse Point – South Coast AQMD Method 1
- Flow – South Coast AQMD Method 2
- Inorganic Gas – South Coast AQMD Method 3
- Moisture – South Coast AQMD Method 4
- EPA “F” Factor Method

Other Methods

- Carbon Monoxide - South Coast AQMD Method 10
- Continuous Monitoring - South Coast AQMD Method 100.1
- Hydrocarbons - South Coast AQMD 25.1
- Hydrocarbons - South Coast AQMD 25.3

Source Testing Requirements
Rule 1110.2 (f)(1)(C)

- Conduct source testing for NOx, VOC, and CO at least once every two years or every 8760 hours of ICE operation
  - Every 3 yrs if ICE operated < 2000 hrs since last source test
  - No pre-tests or pre-test tuning allowed
  - Emission exceedances shall be reported

Source Testing Requirements
Rule 1110.2 (f)(1)(C)

- Conduct test for minimum 30 minutes during normal operation
  - Do not conduct at steady state unless that rate is normal operation
- Additional 15 minute test for NOx & CO at peak or maximum achievable load
- No source tests within 40 operating hours or one week of last ICE service or tuning
- Use only South Coast AQMD approved source testing contractors

Source Testing Requirements Rule 1110.2 (f)(1)(C)

- Submit source test protocol at least 60 days in advance of scheduled test date
- Provide South Coast AQMD at least 30 days prior notice of source test to give South Coast AQMD staff the opportunity to observe test
- Submit all source test reports to South Coast AQMD within 60 days of test completion

Source Testing Requirements Rule 1110.2 (f)(1)(C)

- Within one year of adoption
  - Provide adequate sampling ports
  - Safe sampling platform or stack access
  - Utilities for sampling, as necessary
- Agricultural units exempt from 2nd & 3rd requirements if in remote locations without power

Overview – Rule 1146 & 1146.1

- New Rule Amendments
  - **Periodic Testing**
  - **Recordkeeping**
  - **Training/Certification**
  - **Lower Nox Limits**

Rule 1146 and 1146.1 Background

- Initially adopted in 1988 and 1990
- Rule 1146 units ≥ 5,000,000 btu/hr input rating
- Rule 1146.1 units > 2,000,000 and < 5,000,000 btu/hr input rating
- Applies to units fired by:
  - Natural gas
  - Digester and landfill gases
  - Other fuels

Specialty Units Not Covered in this Training & Certification Presentation

- Units with Continuous Emission Monitoring Systems (CEMS) (Units ≥40 million BTU/Hr input and annual heat input greater than 2,000,000 therms require a NOx CEMS)
- Units subject to RECLAIM
- Units fired by digester and landfill gas or other non natural gas fuels
- Review Rule 1146 and 1146.1 for specific requirements and additional exemptions

Rule 1146 and 1146.1 Amendments

- On September 5, 2008, Rules 1146 and 1146.1 were amended:
  - To assure compliance with rule emission limits by requiring affected sources to conduct frequent emissions testing using a portable analyzer starting 7/1/2009
  - To lower NOx emission limits
  - To no longer allow de-rating of units to 2 million btu/hr or below

Two Types of Units

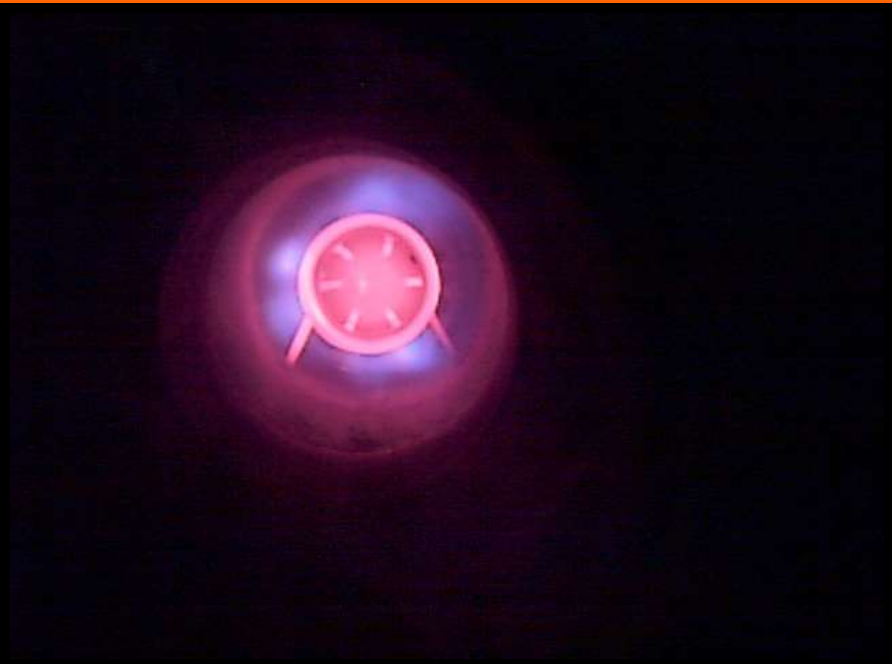
- Atmospheric – Units that operate with an open burner assembly at standard air pressure using natural draft ventilation
- Non-atmospheric - Units that operate with an enclosed burner assembly designed to operate above standard air pressure using forced air ventilation

Typical Atmospheric Unit

Inside View of Atmospheric Unit

Typical Non-atmospheric Unit

Inside View Non-atmospheric Unit



Emission limits for boilers subject to Rule 1146

Unit Type	NOx Limit	Compliance Date
Atmospheric Units	12 ppm	January 1, 2014
Group I Units	5 ppm	January 1, 2013
Group II Units (Fire-tube with previous limit >5 or ≤9 ppm)	7 ppm	December 7, 2033 or 50% burner replacement
Group II Units (Previous limit >5 or ≤12 ppm)	9 ppm	January 1, 2014
Group II Units (All Others)	5 ppm	December 7, 2018
Group III Units (Fire-tube, excluding w/ previous limit >9 or ≤12 pppm)	7 ppm	December 7, 2018*
Group III Units (All Others)	9 ppm	January 1, 2015*
Thermal Fluid Heaters	12 ppm	December 7, 2018*

Rule 1146 Unit Categories

- Group I Units ≥ 75 million btu/hr input rating
- Group II Units ≥ 20 million and < 75 million
- Group III Units ≥ 5 million and < 20 million
- Thermal Fluid Heater – natural gas fired process heater in which a process stream is heated indirectly by a heated fluid other than water.

Emission limits for boilers subject to Rule 1146.1

Unit Type	NOx Limit	Compliance Date
Atmospheric Units	12 ppm	January 1, 2014
Any Unit not covered by these other categories	9 ppm	January 1, 2014*
Any Fire-Tube boilers (except those w/ previous limit >9 and ≤12 ppm)	7 ppm	December 7, 2018*
Thermal Fluid Heaters	12 ppm	December 7, 2018*

- Dates with asterisks have additional compliance dates available.
- Both Rule 1146 and 1146.1 have other unit types listed
- This is a general overview of the rule. Refer to the rules for specifics.

Current Emission Technology Used

- Low NOx burners with pre-mix blowers (Atmospheric Units)
- Low Nox burners in conjunction with Flue Gas Recirculation Systems (FGR) (Non-atmospheric Units)
- Ammonia injection systems

  Has been widely used for very large units (> 75 million btu/hr)

  May be developed for smaller applications to meet new lower NOx limits of 5 and 9 ppm

Portable Analyzer Emission Testing

Portable Analyzer Testing Initial Requirements

- Monthly emission check (or every 750 unit operating hours) using a portable analyzer for Rule 1146 units
- Quarterly emission check (or every 2000 unit operating hours) using a portable analyzer for Rule 1146.1 units
  - No tuning/maintenance within 250 operating hours or 30 calendar days of test
  - Analyzer shall be calibrated, maintained and operated per AQMD's Combustion Gas Periodic Monitoring Protocol which can be found at the following site:

http://www.aqmd.gov/rules/doc/1146&1146.1/FinalCombustionGasPeridodicMonitoring Protocol.pdf

Portable Analyzer Testing Requirements

- Testing required if no NOx and CO CEMS on Unit
- Tester must have AQMD-approved training and certification
- Tester must follow manufacturer specifications for proper use of analyzer.
  - Analyzers are verified by US Environmental Protection Agency (EPA) Environmental Technology Verification Program (ETV)
  - See EPA website: http://www.epa.gov/etv

Rule 1146 Portable Analyzer Testing Requirements

- Monitor for NOx, CO, O_2 (15 minutes data min.)
- Start with monthly testing (or every 750 operating hours) for Rule 1146 units
- Unit may be tested quarterly (or every 2000 operating hours) if three consecutive monthly tests in compliance
  - No adjustments to burner assembly or set points made
- Must resume monthly testing
  - Any noncompliant tests
  - Burner assembly or set point adjustments made
  - Additional emission test is required within 72 hours if operator finds any emissions exceedance and the unit is subsequently repaired and not shut down

Rule 1146.1 Portable Analyzer Testing Requirements

- Monitor for NOx, CO, O_2 (15 minutes data min.)
- Start with quarterly testing (or every 2000 operating hours) for Rule 1146.1 units
- Unit may be tested semi-annually (or every 4000 operating hours) if four consecutive quarterly tests in compliance
  - No adjustments to burner assembly or set points made
- Must resume quarterly testing
  - Any noncompliant tests
  - Burner assembly or set point adjustments made
  - Additional emission test is required within 72 hours if operator finds any emissions exceedance and the unit is subsequently repaired and not shut down

Recordkeeping Requirements

- The facility and the tester will be required to keep records* including:
  - A Measurement System Log
  - Unit Emission Testing Results Log
- Logs must be:
  - Kept on premises for at least 2 years
  - Made available upon request for each measurement system and unit

*Electronically stored records OK if data can be retrieved at all times

Measurement System Log

- Linearity and Stability Forms (Form 1 & 4) must be completed/signed by trained personnel
- Calibration/Recordkeeping Form (Form 2) must be completed/signed by trained personnel
- Certificates of analysis for all calibration gases listed on Forms 1, 2 & 4 must be available
- All maintenance/service records, including cell and filter replacement dates, purchases

Unit Compliance Log

- Periodic Testing Results Form 3B must be completed/signed by trained personnel
- Source test reports

Source Testing Requirements

- Conduct source testing for NOx and CO once every three years for units ≥ 10 million Btu/hr input and once every 5 years for units > 2 million and < 10 million Btu/hr input
  - No source tests within 250 operating hours or 30 calendar days of last unit service or tuning
  - Use only AQMD approved source testing contractors
  - Emission exceedances shall be recorded and reported. No violation if unit repaired and re-tested showing compliance within 72 hours.
  - Submit source test protocol 60 days prior to test, inform AQMD 30 days prior to test date, submit test results report within 60 days of test.
  - Requires special equipment and procedures different from a portable analyzer.

Questions?

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