

Continuous Emission/Opacity Monitoring System (CEMS/COMS) and Data Acquisition and Handling System (DAHS) Audits – Experiences and Findings

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ABSTRACT

Continuous Emission/Opacity Monitoring Systems (CEMS/COMS) and Data Acquisition and Handling Systems (DAHS) are critical components of many facilities' air compliance programs. A strong working knowledge of the hardware, software, and applicable regulations is required to fully understand these extremely complex systems; further, many who work around these systems only do so on a limited basis. As such, shortcomings in these systems often go unnoticed; in some cases such shortcomings may consist of potentially serious compliance issues that come to light during a compliance audit. Thus, facilities may want to periodically pursue internal or third-party audits of their CEMS/COMS/DAHS and/or their air program in general. In particular, a review may be warranted for numerous reasons such as permit or regulation revisions, changes in staff, hardware/software updates, facility purchase/expansion, preparation for an upcoming compliance audit, or due to a general lack of confidence in the existing program/systems. DSG Solutions has performed CEMS/COMS/DAHS audits at numerous power generation facilities across the country in recent years and we will share some of our experiences and findings.



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CEMS/COMS/DAHS Audits Experiences and Findings

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About Us

DSG Solutions, LLC supports the energy industry with air management services focusing on air emissions monitoring, testing, recordkeeping and reporting requirements related to 40 CFRs 60, 63, 64, 75 and 98 as well as State and local air quality regulations.

- Audits
- Training
- Report Preparation
- New Regulations
- As-Needed Support

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CEMS & COMS

Continuous Monitoring Systems

- CEMS = Emission
 - Probe / Umbilical
 - Sample Conditioner
 - Monitors (e.g. NO_x, CO, O₂)
 - Calibration cylinders
- COMS = Opacity
 - Light source
 - Retro-reflector
 - Transceiver
 - Calibration attenuators

Background

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Findings

Conclusions

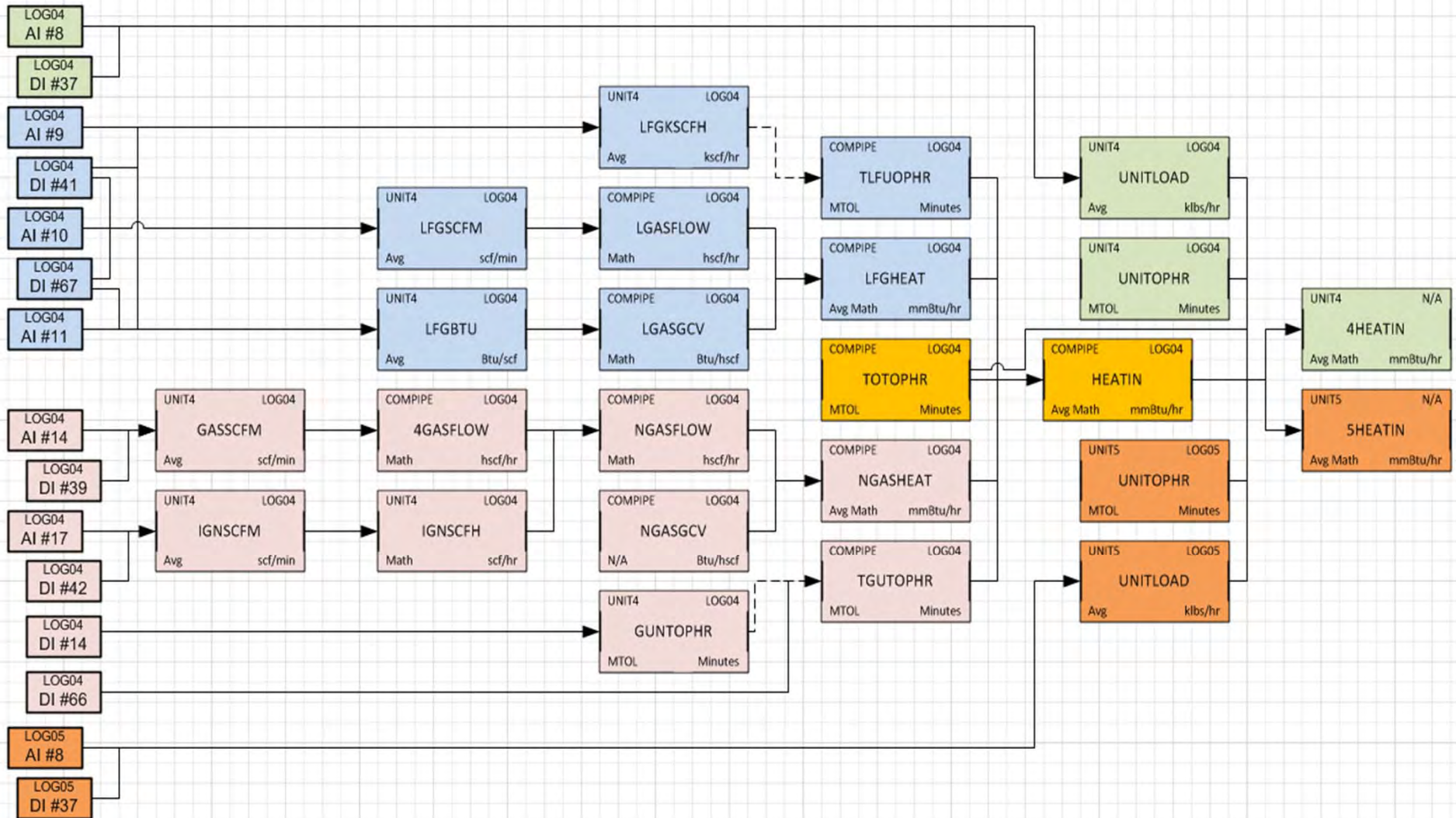
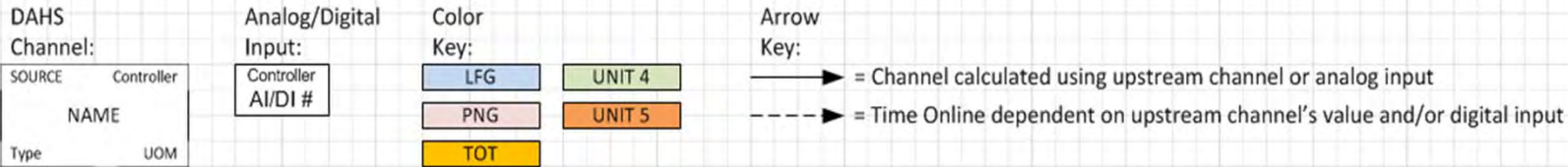
DAHS

DAHS = Data Acquisition and Handling System

- Many vendors, one purpose: compliance software
- Real-time monitoring/alarms
- Recordkeeping & reporting
- Varying levels of complexity



Legend:



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Beyond Hardware & Software



- People
 - Environmental Managers
 - Control Room Operators
 - Instrument Technicians
- Procedures
 - Maintenance & testing
 - Data Edits
 - Recordkeeping
 - Quality Assurance (QA)/
Quality Control (QC) Plan

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Why Audit?

- New or revised requirements
 - Air permit
 - Regulations
- Changes to
 - Hardware/software
 - Staff/ownership
- Compliance audit preparation
- General concerns
- Continuous improvement

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Scope & Formality



Scope

Comprehensive
Informal
DAHS Review

Comprehensive
Formal
DAHS Audit

3

4

1

2

Focused Informal
DAHS Review

Focused Formal
DAHS Audit



Formality



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Typical Sequence

Next

1. Request for information
2. Document review
3. On-site review
 - Kickoff meeting
 - Q&A w/ relevant personnel
 - Hardware configuration
 - DAHS data/configuration
 - Recordkeeping
 - Closeout meeting
4. Audit report
5. Optional: Revisions/follow-up



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Misconfigured Channel #1 NO_x 3-hr Rolling Averages

- 3-hr rolling NO_x lb/mmBtu & lb/hr; operate close to limit
- Used NO_x ppm @ 15% O₂ in NO_x lb/mmBtu calculation so were underreporting ~25%
- Thousands of unreported exceedances identified

Calculated 3-Hr NO_x Exceedances Using 2010Q1-2015Q3 EDR Data

Year	Quarter	CT1		CT2	
		lb/mmBtu	lb/hr	lb/mmBtu	lb/hr
Total		128	100	1,485	1,353



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Misconfigured Channel #2 NO_x “Merge” Channel

- Dual-range NO_x analyzer
- DAHS configured to use the high range data at all times
- High limits so dodged a bullet, but a facility with lower limits might not have been so lucky

Channel				Primary		Secondary		Switch on
#	Name	Type	Units	#	Name	#	Name	Flags
26	NOXPPM	J	PPM	15	NOXHIGH	16	NOXLOW	H



Over-ranged Channel Data "Pegged Out" & "Valid"

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Timestamp	(Turbine - 1) Process Code 1-Min	(Turbine - 1) 60-NOx ppm 1-Min	(Turbine - 1) 75-NOx ppm 1-Min	(Turbine - 1) CO ppm 1-Min
12/22 5:07	2	51.19	51.19	26.73
12/22 5:08	2	51.19	51.19	27.57
12/22 5:09	2	51.19	51.19	28.85
12/22 5:10	2	51.19	51.19	27.83
12/22 5:11	2	51.19	51.19	26.75
12/22 5:12	2	51.19	51.19	26.70
12/22 5:13	2	51.19	51.19	26.63
12/22 5:14	2	51.13	51.13	27.43
12/22 5:15	2	45.41	45.41	27.28
12/22 5:16	2	33.32	33.32	27.57
12/22 6:18	2	2.62	2.62	342.68
12/22 6:19	2	2.16	2.16	717.08
12/22 6:20	2	1.45	1.45	1220.88
12/22 6:21	2	1.99	1.99	1541.08
12/22 6:22	2	2.97	2.97	1564.30
12/22 6:23	2	3.90	3.90	1564.30
12/22 6:24	2	4.80	4.80	1564.30
12/22 6:25	2	5.58	5.58	1564.30
12/22 6:26	2	6.26	6.26	1564.30
12/22 6:27	2	6.51	6.51	1564.30



Background

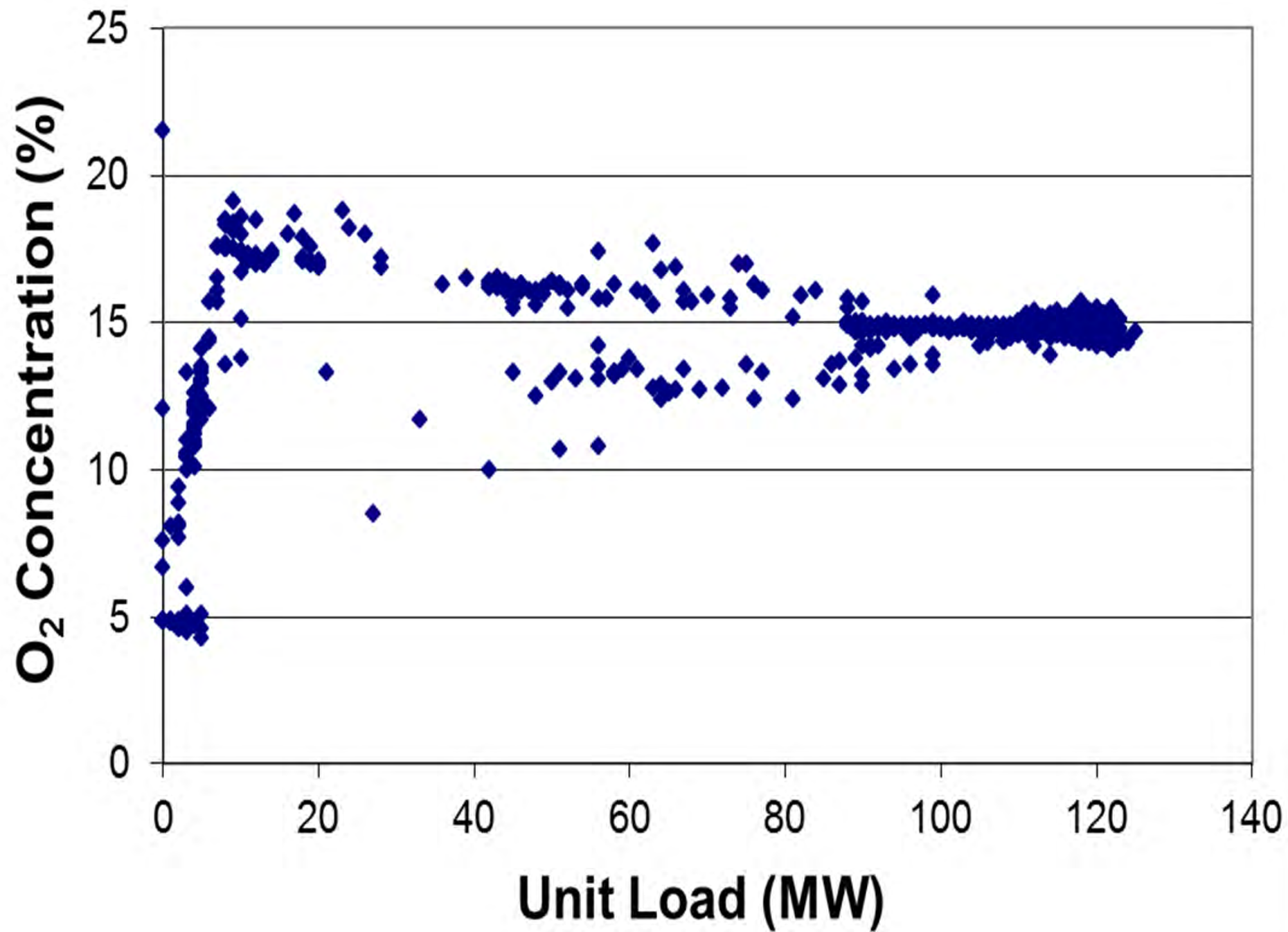
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Other Observed Software Configuration Issues

- Fuel data units of measure
- 6-minute data aggregation
- Calibration passing criteria
- Invalid data propagation
- Pre-DAHS programming errors
 - Frozen MW signals
 - Bad O₂ data during startup



Falsified Data

- Overwhelmed technician
- Copied/pasted linearity data

Date/Time	RNOXHI	NOXHIGH	Date/Time	NOXHIGH	Match?
07/02/2014 12:23	8.5	8.5	06/24/2014 11:23	2.7	FALSE
07/02/2014 12:24	8.4	8.3	06/24/2014 11:24	1.1	FALSE
07/02/2014 12:25	8.1	8.1	06/24/2014 11:25	12.9	FALSE
07/02/2014 12:26	7.9	8	06/24/2014 11:26	22.9	FALSE
07/02/2014 12:27	8.1	8.1	06/24/2014 11:27	6.2	FALSE
07/02/2014 12:28	8	8	06/24/2014 11:28	6.4	FALSE
07/02/2014 12:29	7.9	7.8	06/24/2014 11:29	5.7	FALSE
07/02/2014 12:30	8	16.6	06/24/2014 11:30	16.6	TRUE
07/02/2014 12:31	7.9	19.1	06/24/2014 11:31	19.1	TRUE
07/02/2014 12:32	7.9	20.1	06/24/2014 11:32	20.1	TRUE
07/02/2014 12:33	7.4	23.6	06/24/2014 11:33	23.6	TRUE
07/02/2014 12:34	8	23.6	06/24/2014 11:34	23.6	TRUE
07/02/2014 12:35	3.8	23.7	06/24/2014 11:35	23.7	TRUE
07/02/2014 12:36	6.9	23.8	06/24/2014 11:36	23.8	TRUE
07/02/2014 12:37	8.4	8.3	06/24/2014 11:37	8.3	TRUE

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Other Observed User Errors

- EPA not copied on reports
- Post-maintenance quality assurance testing, validity
- Data edits not propagated to downstream data
- Data entry (e.g. PGVP)



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Airgas, Inc.

600 Lewis Landing Road

Cinnaminson, NJ 08047

856-681-7475 Fax: 856-624-8716

Part Number: E04N82E15A1990
Cylinder Number: S09199675BAL
Laboratory: ASG - Riverton - NJ
PGVP Number: B52015
Gas Code: CO2, NO, NOX, SO2, BALN

Reference Number: 82-124483243-1
Cylinder Volume: 154.6 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Mar 25, 2015

Expiration Date: Mar 25, 2023

Certificates are generated by a computer using the EPA Traceability Protocol for Airgas and Certification of Gas Analysis Standards (May 2012) document EPA 8200-K-12-001, using the actual measurement. Analytical Methodology: Gas not being certified for analysis. This cylinder has a test analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration material. All concentrations are on a volumetric basis unless otherwise noted.

Do Not Use This Cylinder Before 100,000 psi or 5.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
NOX	180.0 PPM	179.5 PPM	G1	±0.8% NIST Traceable	03/18/2015, 03/25/2015
NITRIC OXIDE	180.0 PPM	179.5 PPM	G1	±0.8% NIST Traceable	03/18/2015, 03/25/2015
SULFUR DIOXIDE	350.0 PPM	352.0 PPM	G1	±1.0% NIST Traceable	03/18/2015, 03/25/2015
CARBON DIOXIDE	17.00 %	17.12 %	G1	±1.0% NIST Traceable	03/18/2015
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	12061060	DC350615	500.7 PPM NITRIC OXIDE/NITROGEN	±0.8%	Feb 16, 2016
PRM	12312	680179	10.01 PPM NITROGEN DIOXIDE/NITROGEN	±2.0%	Oct 15, 2014
DMIS	12425688117	DC323703	4.449 PPM NITROGEN DIOXIDE/NITROGEN	±2.0%	Aug 14, 2017
PRM	11996618	CC153396	241.0 PPM SULFUR DIOXIDE/NITROGEN	±0.8%	May 18, 2017

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Other Findings

- Analyzer installation locations
- NH_3 correction factors
- Gas cylinder requirements
- Part 75 control status checks



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Conclusions

- Audits are challenging!
- Complex systems warrant periodic review, especially following changes
- Build a team atmosphere
- Training can go a long way
- Continuous improvement





Questions?

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