UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

FEB 17 2011

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Guidance on Statistics for Use at Audit Levels 1 and 2 of the Expanded List of Audit Levels for Annual Performance Evaluation for SO_2, NO_2, O_3, and CO as Described in 40 CFR Part 58 Appendix A Section 3.2.2

FROM: Lewis Weinstock, Group Leader
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Ambient Air Monitoring Group (C304-06)

TO: Air Monitoring Program Managers and Staff

On November 18, 2010, a technical memorandum[1] that allowed for the expansion of the performance evaluation audit levels from five (currently in CFR) to ten was distributed. The expansion allowed EPA to provide lower audit levels for use at NCore sites or sites reporting low routine concentrations and tightened up the span within each level to provide more choices of ranges where routine concentrations are being measured.

We have received comment from monitoring organizations and EPA Regions expressing concerns that the lower audit ranges will create large, unreasonable percent differences (PDs) if the same statistics and current acceptance limits are used. They are suggesting that EPA look to a different statistic at these lower audit ranges.

Using 1-point QC check data and annual performance evaluation data in AQS, recent NPAP through-the-probe data at NCore sites and some low concentration calibration information from our RTP Ambient Air Innovation Research Station (AIRS), EPA evaluated the effect of low-level concentrations against our current PD statistic. Attachment 1 provides the results of this evaluation.

[1] Expanded List of Audit Levels for Annual Performance Evaluation for SO_2, NO_2, O_3, and CO as Described in 40 CFR Part 58 Appendix A Section 3.2.2 http://www.epa.gov/ttn/amtic/cpreldoc.html

Based on this assessment, EPA suggests the use of the following acceptance criteria for levels 1 and 2 audit ranges:

- For O_3, SO_2, and NO_2: $\pm$ 1.5 ppb difference or $\pm$ 15 percent difference, whichever is greater.
- For CO: $\pm$ 0.03 ppm difference or $\pm$ 15 percent difference, whichever is greater.

For audit levels 3-10, the 15 percent difference acceptance criteria, currently in guidance, appears achievable. We do not have as much information on NO_2, even at audit level 3, so we will need to look at this level more carefully as data become available.

As additional low-level audit data become available, OAQPS will work with the EPA Regions and monitoring organizations to review these results to determine the performance of the acceptance criteria described above. Since the acceptance criteria for the PEs are in the QA Handbook and not in regulation, it will be much simpler to implement this change.

Changes in the AMP255 report will take longer to complete. Due to the number of revisions in AQS for other monitoring activities, including the changes needed to expand the audit levels, AQS may not be able to institute this change on short order. Since the May 2011 data certification will be based on 2010 data (which follows the current audit levels and acceptance criteria), the AMP255 report will not be affected by the new statistic for the 2010 certification period. The AMP255 report will be revised by the May 2012 certification deadline. We will update EPA Regions and monitoring organizations of the timing on the changes to the AMP255 report.

Please make your monitoring organizations aware of this new guidance. We will also develop some information more specific about the AMP255 report that will be posted on AMTIC as well as sent to all the AQS contacts.

If you have any questions, please contact Mike Papp at (919) 541-2408 or email to papp.michael@epa.gov.

Attachment

ATTACHMENT 1

Preliminary Assessment of Data for Use in a Low-Level Precision and Bias Statistic

Background

EPA has requested that monitoring organizations attempt to implement the 1-point quality control (QC) checks (40 CFR part 58 App A Section 3.2.1) and the annual performance evaluation audits (40 CFR part 58 App A Section 3.2.2) at concentration ranges that are similar to the ambient air concentrations they are measuring in their networks. With the implementation of trace gas monitoring in the NCore network and the overall reduction in ambient air pollutant concentrations being observed in most parts of the country, this guidance will require monitoring organizations to lower the audit concentrations for these quality control checks.

Implication of Lower Audit Concentrations

Current statistics for both audits use percent difference (PD) as the initial calculation as described in equation 1 of 40 CFR part 58 App A Section 4.1

$$d_i = \frac{meas - audit}{audit} X100$$

Where *meas* is the concentration indicated by the monitoring organization's instrument and *audit* is the audit concentration of the standard used in the QC check being measured.

Based on previous audit ranges, the use of this statistic was reasonable and data assessments showed that over 95 percent of the sites were meeting the PD acceptance criteria (7-10 percent for the 1-point QC checks and 15 percent for the performance evaluations). However, the monitoring organizations have concerns that lowering audit ranges will create large, unreasonable PDs if the same statistics and current acceptance limits are used. They are suggesting that EPA look to a different statistic at these lower audit ranges.

The intent of this paper is to provide some preliminary results and guidance on the use of an alternative statistic at lower audit concentrations.

Current Audit Concentration Ranges

The 1-point quality control check--

- 0.01– 0.10 ppm for O_3, SO_2 and NO_2 ,
- and 1-10 ppm for CO

The annual performance evaluation--

A recent technical memorandum[1] has expanded the number of audit levels currently in CFR to the levels in Table 1.

Table 1. Expanded Audit Levels

Audit Level	Concentration Range, ppm			
	O_3	SO_2	NO_2	CO
1	0.004-0.0059	0.0003-0.0029	0.0003-0.0029	0.020-0.059
2	0.006-0.019	0.0030-0.0049	0.0030-0.0049	0.060-0.199
3	0.020-0.039	0.0050-0.0079	0.0050-0.0079	0.200-0.899
4	0.040-0.069	0.0080-0.0199	0.0080-0.0199	0.900-2.999
5	0.070-0.089	0.0200-0.0499	0.0200-0.0499	3.000-7.999
6	0.090-0.119	0.0500-0.0999	0.0500-0.0999	8.000-15.999
7	0.120-0.139	0.1000-0.1499	0.1000-0.2999	16.000-30.999
8	0.140-0.169	0.1500-0.2599	0.3000-0.4999	31.000-39.999
9	0.170-0.189	0.2600-0.7999	0.5000-0.7999	40.000-49.999
10	0.190-0.259	0.8000-1.000	0.8000-1.000	50.000-60.000

Initial Data Assessment

In order to determine what steps to take, EPA performed evaluations of data from:

- 1-point quality control checks (2009),
- Annual performance evaluations (2008-2010),
- NPAP TTP audits at NCore sites where lower audit concentrations are being evaluated, and
- Low-level calibrations performed in January 2011 at the RTP Ambient Air Innovation Research Station (AIRS).

At a minimum, this information will allow EPA to evaluate the achievement of precision and bias at levels that can be related to current concentration ranges in Table 1.

1-Point Quality Control Check and Annual Performance Evaluation Data

1-Point Quality Control Check--

EPA acquired 1-point QC data from all sites with monitor types: SLAMS, Tribal, NCore, Proposed Ncore, and Special Purpose for Calendar Years 2008-2010. Since there was quite a bit of 1-point data available in any one year, only 2009 data were used for the assessment (if necessary, we can evaluate the other years). Figures 1, 3, 6, and 9 provide the results for the four gaseous pollutants. The 1-point QC data were aggregated by the audit levels defined in Table 1 above. At each audit level that had data, the average absolute percent difference (indicated by blue line in the figures) and the absolute difference (indicated by red line in the figures) was calculated. Since we would be aggregating/averaging data by

[1] Use of Expanded List of Audit Levels for Annual Performance Evaluation for SO2, NO2, O3, and CO as Described in 40 CFR Part 58 Appendix A Section 3.2.2 http://www.epa.gov/ttn/amtic/cpreldoc.html

audit levels, absolute values were used to avoid "cancelling out" positive and negative PDs. In addition, there is an asterisk (*) in each row that represents the required concentration range for the 1-point QC check.

Annual Performance Evaluation (PE) Data--

Since only one PE audit is required for each site each year, 2008-2010 data were used in order to have an adequate number of audits at any level that was audited. We used the same statistics as the 1-point checks and aggregated the data at the Table 1 audit levels. Figures 2, 4, 7, and 10 represent the PE data for gaseous pollutants.

Precision and Bias Simulation Using 1-Point QC and Annual PE Data

In addition to evaluating the 1-point QC data and annual PE separately, we attempted to simulate what a 3-year precision and bias estimate would be for a typical monitoring site at each level where we had enough information to perform this assessment. We aggregated 1-point QC data and annual PE by concentration levels (an audit level pool). Each audit level pool has a different number of audits in the original data. For example, the ozone audit level 3 had 1,602 values pooled while SO_2 audit level 3 had 235 values pooled. Since a 3-year precision and bias assessment is performed using the 1-point QC checks, which are required to be sampled every 14 days (26 values per year), over a 3-year period one would expect a minimum of 78 precision/bias values per site.

From each audit level pool, we randomly selected 78 values with replacement using SAS to create a single bootstrap sample for which we estimated bias and precision based on the current statistics in the CFR. The precision estimate is a 90 percent confidence limit of the coefficient of variation and the bias is a 95 percent confidence limit for the absolute bias[2]. We performed this random selection of 78 values from each audit pool 1,000 times to create 1,000 bootstrap samples containing 78 values each. We then estimated the bias and precision on each of the 1,000 samples so that each audit level pool had 1,000 simulated precision and bias estimates. We then calculated the mean and 95 percent confidence limits about the mean for each audit level pool which contained 1,000 simulated precision and bias estimates. These are provided in the estimates tables for each pollutant and audit level Tables 3, 4, and 5. The simulation was not performed on NO_2 due to lack of enough data values at low levels.

Calibrations at the RTP Ambient Air Innovation Research Station (AIRS)

In January 2011, EPA's monitoring support contractor ran some back of the analyzer calibrations points with a low-level audit cylinder and a mass flow controller (size 50 SCCM for low levels) in the API M700EU calibration/dilution system. Calibration points were run for CO, NO_2, and SO_2.

All assessments performed will be aggregated by pollutant on the following pages.

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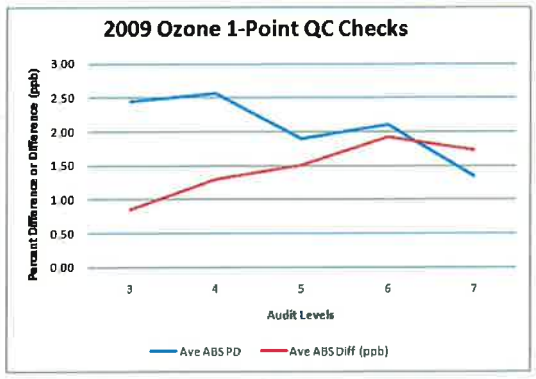
[2] Guideline on the Meaning and the Use of Precision and Bias Data Required by 40 CFR Part 58 Appendix A http://www.epa.gov/ttn/amtic/qareport.html

Data Evaluation - Ozone

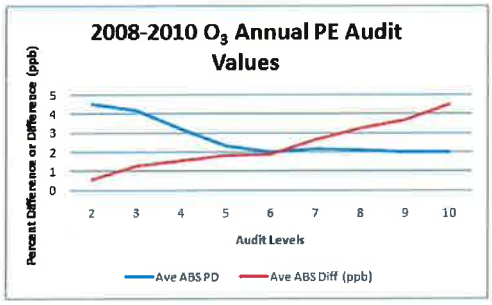
For the ozone 1-point QC checks (Fig. 1), there were no audits at levels 1, 2, 8, 9, or 10. The CFR requires 1-point checks that corresponded to audit ranges 2-6. The average PDs for all levels are within the 7 percent ozone acceptance criteria.

For ozone annual performance evaluations (Fig. 2), there were audits at levels 2-10. All audit levels are well within the 15 percent acceptance criteria for the performance evaluations. Ozone has traditionally had the least amount of variability and bias among the gaseous pollutants.



1 Point QC	Audit Level	Audit Level Conc (ppb)	Number of Pairs	Ave ABS PD	Ave ABS Diff (ppb)
	1	4.0-5.9	0	NA	NA
*	2	6.0-19	0	NA	NA
*	3	20-39	70	2.44	0.86
*	4	40-69	918	2.56	1.31
*	5	70-89	27737	1.89	1.52
*	6	90-119	26184	2.10	1.93
	7	120-139	45	1.35	1.74

Figure 1. O3 1-point QC Check



PE Audit Level	Audit Level Conc (ppb)	Number of Pairs	Ave ABS PD	Ave ABS Diff (ppb)
1	4.0-5.9	0	NA	NA
2	6.0-19	3	4.50	0.57
3	20.0-39	1401	4.19	1.32
4	40.0-69	3100	3.20	1.58
5	70.0-89	4020	2.34	1.82
6	90.0-119	1233	2.01	1.90
7	120.0-139	504	2.16	2.68
8	140.0-169	2090	2.11	3.27
9	170.0-189	2972	2.02	3.68
10	190.0-259	2783	1.98	4.50

Figure 2. O3 Annual PE (2008-2010)

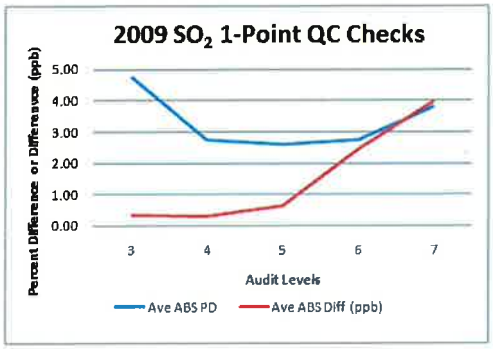
For the pooled ozone simulation, there was not enough data to aggregate into pools for audit levels 1 or 2, so the simulations were run at levels 3 and 4. Table 2 provides the results of the simulation. The precision and bias simulation results are greater than the absolute percent difference at the same audit levels in Figures 1 and 2 due to the use of confidence limits in the CFR statistics. This will be evident in each pollution evaluation. Simulations show that precision and bias at audit levels 3 and 4 are within the 7 percent acceptance criteria for ozone 1-point QC.

Table 2. O3 Precision and Bias Estimate based on a 1000 Run Data Simulation

Audit Level	n	Precision		Bias	
		Mean	95% CL	Mean	95% CL
3	1602	5.31	5.26-5.35	4.11	4.08-4.14
4	5042	4.11	4.06-4.15	3.12	3.10-3.15

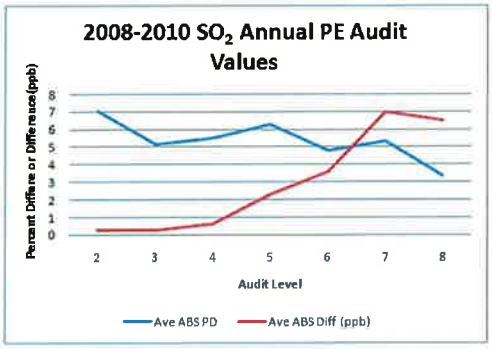
An ozone calibration was not performed at the time this report was written.

Data Evaluation – Sulfur Dioxide



1 Point QC	PE Audit Level	Audit Level Conc (ppb)	Number of pairs	Ave ABS PD	Ave ABS Diff (ppb)
	1	0.3-2.9	0	0	0
	2	3.0-4.9	0	0	0
	3	5.0-7.9	27	4.72	0.34
*	4	8.0-19.9	1830	2.73	0.32
*	5	20.0-49.9	789	2.60	0.63
*	6	50.0-99.9	11391	2.76	2.45
*	7	100.0-149.9	947	3.78	3.98

Figure 3. SO2 1-point QC Check



PE Audit Level	Audit Level Conc (ppb)	Number of Pairs	Ave ABS PD	Ave ABS Diff (ppb)
1	0.3-2.9	3	3.68	0.11
2	3.0-4.9	98	7.05	0.31
3	5.0-7.9	170	5.13	0.29
4	8.0-19.9	397	5.50	0.61
5	20.0-49.9	257	6.27	2.30
6	50.0-99.9	2283	4.77	3.58
7	100.0-149.4	119	5.32	6.98
8	150.0-259.5	1710	3.38	6.49
9	260.0-799.9	2150	3.36	15.74
10	800.0-1000	127	3.68	30.12

Figure 4. SO2 Annual PE (2008-2010)

For the SO_2 1-point QC checks (Fig. 3), there were no audits at levels 1, 2, 8, 9, or 10. The CFR requires 1-point checks that corresponded to audit ranges 4-7. There were 27 audit pairs audited at level 3, which is lower than the requirement, and the average PDs for all levels are within the 10 percent SO_2 acceptance criteria.

For SO_2 annual performance evaluations (Fig. 4), although there were audits at all 10 levels, levels 9 and 10 were not graphed because of the effect it would have on the display of the data (would expand the y axis to 30 which would condense the graph at the low end). All audit levels are within the 15 percent acceptance criteria for the PEs.

For the SO_2 audit data simulation, we had enough data at audit levels 2 and 3 to aggregate into pools for the simulation. Table 3 provides the results. As indicated in ozone, the simulation precision and bias means are larger than the percent difference estimates in Figures 3 and 4 for the same audit levels. However, they are still within the 10 percent precision and bias acceptance criteria.

Table 3. SO2 Precision and Bias Estimate based on a 1000 Run Data Simulation

Audit Level	n	Precision		Bias	
		Mean	95% CL	Mean	95% CL
2	98	9.67	9.59-9.74	7.91	7.86-7.96
3	235	8.82	8.68-8.96	5.91	5.85-5.98

The AIRS calibration was run back of the analyzer with a low level audit cylinder (13.38 ppm standard) and our new mass flow controller (size 50 SCCM for low levels) in the API M700EU calibration/dilution system. The results are presented in Figure 5. We were able to produce reliable results at audit levels 1-6. All points were within the 15 percent acceptance limits for the performance evaluation.

Level No.	Response (ppb)	Expected (ppb)	Difference (ppb)	% Diff
6.00	88.64	90	-1.36	-1.51
5.00	40.35	40	0.35	0.88
5.00	20.20	20	0.20	1.00
4.00	12.00	12	0.00	0.00
3.00	5.94	6	-0.06	-1.00
2.00	3.89	4	-0.11	-2.75
1.00	1.84	2	-0.16	-8.00
ZA	-0.03	0	-0.03	NA

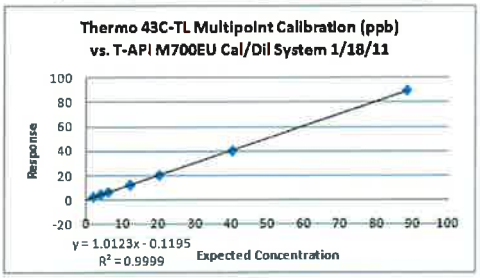
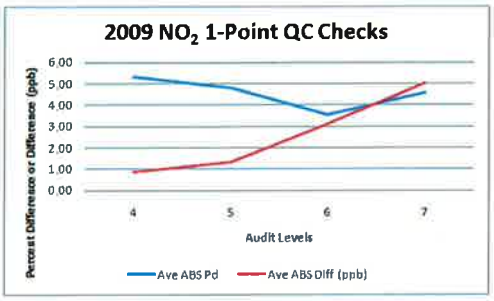


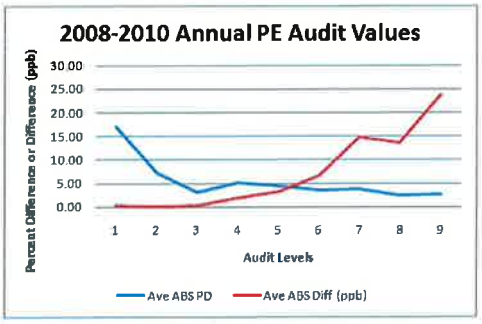
Figure 5. SO2 multipoint calibration

Data Evaluation – Nitrogen Dioxide



I Point QC	PE Audit Level	Audit Level Conc (ppb)	Number of Pairs	Ave ABS Pd	Ave ABS Diff (ppb)
	1	0.3-2.9	0	0	0
	2	3.0-4.9	0	0	0
	3	5.0-7.9	0	0	0
*	4	8.0-19.9	70	5.33	0.89
*	5	20.0-49.9	160	4.81	1.35
*	6	50.0-99.9	12375	3.54	3.11
*	7	100.0-299.9	1188	4.56	5.03

Figure 6. NO2 1-point QC Check



PE Audit Level	Audit Level Conc (ppb)	Number of Pairs	Ave ABS PD	Ave ABS Diff (ppb)
1	0.3-2.9	2	17.08	0.34
2	3.0-4.9	5	7.07	0.29
3	5.0-7.9	1	3.22	0.34
4	8.0-19.9	6	5.18	2.09
5	20.0-49.9	258	4.50	3.26
6	50.0-99.9	2284	3.64	6.67
7	100.0-299.9	120	3.90	14.90
8	300.0-499.9	0	2.45	13.61
9	500.0-799.9	0	2.74	23.93
10	800.0-1000	0	NA	NA

Figure 7. NO2 Annual PE (2008-2010)

For NO_2 (Fig. 6), there were no 1-point QC checks at audit levels 1, 2, 3, 8, 9, or 10. The CFR requires 1-point checks that corresponded to audit ranges 4-7. There were no audit pairs at levels below the required 1-point precision levels and the average PDs for all levels are within the 10 percent NO_2 acceptance criteria.

For NO_2 annual performance evaluations (Fig. 7), there were audits at levels 1-7 although there were very few audit values at levels 1-4 and not enough to make any definitive evaluation or statements on the percent difference. With the exception of audit level 1 (two audit pairs), average PDs are within the 15 percent acceptance criteria for the PEs.

For the NO_2 audit pool simulation, we did not have enough data in AQS to perform any meaningful simulations at levels 1-3.

The AIRS calibration was run back of the analyzer with a low-level audit cylinder (9.70 ppm standard) and our new mass flow controller (size 50 SCCM for low levels) in the API M700EU calibration/dilution system. The results are presented in Figure 8. We challenged the instrument at levels 2 through 4. The percent differences are greater than 15 percent and the actual difference is around 1.5 ppb.

Audit Level	NO2 Target	NO	NO2 Response	NOX	Diff	% Diff
ZA	0.00	0.09	0.01	0.10	0.01	na
SPAN 40ppb	0.00	40.76	-0.36	40.40	-0.36	na
4	10.73	30.03	9.42	39.45	-1.31	-12.17
3	6.86	33.90	5.20	39.09	-1.66	-24.22
3	6.84	33.92	5.11	39.03	-1.73	-25.34
2	4.66	36.10	3.19	39.29	-1.47	-31.54
2	4.16	36.60	2.95	39.55	-1.21	-29.13

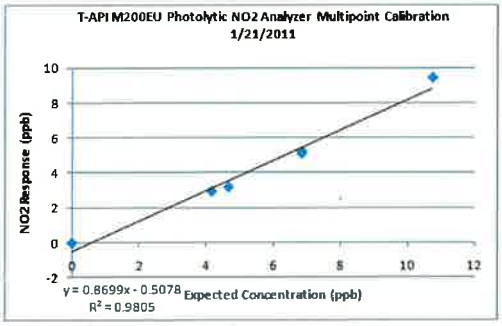
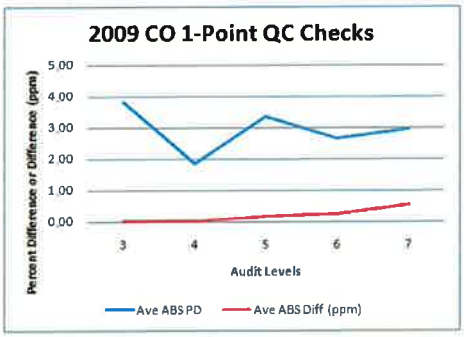


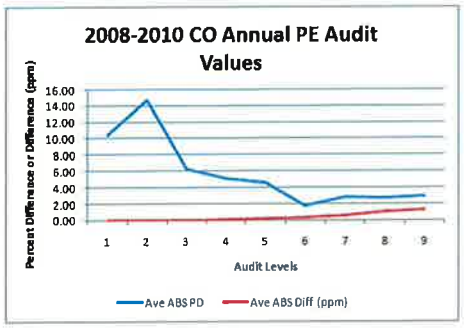
Figure 8. NO2 multipoint calibration

Data Evaluation – Carbon Monoxide



1 Point QC	Audit Level	Audit Level Conc (ppm)	Number of Pairs	Ave ABS PD	Ave ABS Diff (ppm)
	1	0.020-0.059	0	0	0
	2	0.060-0.199	0	0	0
	3	0.200-0.899	490	3.83	0.02
*	4	0.900-2.999	162	1.84	0.02
*	5	3.000-7.999	403	3.34	0.20
*	6	8.000-15.999	10823	2.66	0.25
	7	16.000-30.999	23	2.95	0.53

Figure 9 CO 1-point QC Checks



PE Audit Level	Audit Level Conc (ppm)	Number of Pairs	Ave ABS PD	Ave ABS Diff (ppm)
1	0.020-0.059	10	10.37	0.005
2	0.060-0.199	110	14.72	0.014
3	0.200-0.899	212	6.29	0.035
4	0.900-2.999	283	5.05	0.104
5	3.000-7.999	1651	4.59	0.201
6	8.000-15.999	1777	1.73	0.298
7	16.000-30.999	854	2.81	0.581
8	31.000-39.999	597	2.71	1.002
9	40.000-50.000	818	2.96	1.243
10	50.000-60.000	0	NA	NA

Figure 10. CO Annual PE (2008-2010)

For CO (Fig. 9), there were no 1-point QC checks at audit levels 1, 2, 9, or 10. The CFR requires 1-point checks that corresponded to audit ranges 4-6. There were 490 audit pairs at level 3 below the required 1-point precision levels, and the average PDs for all levels are within the 10 percent CO acceptance criteria.

For CO annual performance evaluations (Fig.10), there were audits at levels 1-9 although there were very few audit values at level 1 and not enough to make any definitive evaluation or statements on the percent difference. Mean PDs of all audit levels are within the 15 percent acceptance criteria for the PEs.

For the CO audit data simulation, we had enough data at audit levels 2 and 3 to aggregate to pools for the simulation. Table 4 provides the results. Simulation results for level 2 show that bias and precision are outside the 10 percent precision and bias acceptance criteria for CO. Level 3 is achieving the acceptance criteria. As a note, levels 2 and 3 are not currently required to be audited for 1-point QC checks.

Table 4. CO Precision and Bias Estimate based on a 1000 Run Data Simulation

Audit Level	n	Precision		Bias	
		Mean	95% CL	Mean	95% CL
2	113	22.67	22.48-22.85	16.42	16.28-16.55
3	1336	7.79	7.53-8.06	5.37	5.28-5.46

The AIRS calibration was run back of the analyzer with a low-level audit cylinder (303 ppm standard) and our new mass flow controller (size 50 SCCM for low levels) in the API M700EU calibration/dilution system. The results are presented in Figure 11. We were able to produce reliable results at audit levels 1-5. All points were within the 15 percent performance evaluation acceptance limits.

Audit Level	Response	Expected	Difference	% Diff
ZA	0.007	0.000	0.007	NA
5	4.003	4.000	0.003	0.08
4	2.494	2.500	-0.006	-0.24
3	0.824	0.800	0.024	3.00
3	0.416	0.400	0.016	4.00
2	0.186	0.180	0.006	3.33
1	0.050	0.050	0.000	0.60
ZA	0.007	0.000	0.007	NA

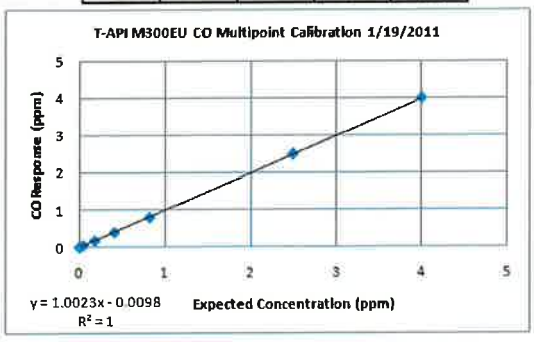


Figure 11. CO multipoint calibration

National Performance Audit Program (NPAP) Data From NCore Sites

EPA has been testing the NPAP "through-the-probe" (TTP) mobile laboratories procedures in order to challenge the NCore sites at lower audit concentration ranges. Table 5 provides the results of SO_2, CO, and O_3. Some of the sites tested were not "official" NCore sites, but they did have trace gas analyzers. Very few sites had NO_2 audits so the data are not presented. The last column in Table 5 (Audit Level) corresponds to the audit levels in Table 1. With the exception of O_3, most of the lowest levels on NPAP audits for CO and SO_2 are conducted at level 2.

Table 5. Trace Gas NCore NPAP TTP

	SO2 (ppm)				
	Audit	Meas	ABS %diff	ABS Diff	Audit Level
Tampa	0.003	0.004	34.67	0.001	2
Pensacola	0.002	0.002	20.00	0.000	2
Charlotte	0.004	0.003	37.50	0.002	2
Millbrook	0.002	0.004	100.00	0.002	2
Jacksonville	0.006	0.007	16.67	0.001	3
BC- Teco	0.004	0.003	25.00	0.001	2
BC- API	0.004	0.003	25.00	0.001	2

	CO (ppm)				
	Audit	Meas	ABS %diff	ABS Diff	Audit Level
Tampa	0.110	0.147	33.64	0.037	2
Pensacola	0.090	0.044	51.11	0.046	2
Charlotte	0.090	0.097	7.78	0.007	2
Millbrook	0.050	0.081	62.00	0.031	1
Broward	0.070	0.097	38.57	0.027	2
Jacksonville	0.140	0.563	302.14	0.423	2
AIRS- Teco	0.090	0.094	4.44	0.004	2
AIRS- API	0.090	0.103	14.44	0.013	2

	O3 (ppm)				
	Audit	Meas	ABS %diff	ABS Diff	Audit Level
Tampa	0.037	0.034	7.84	0.003	3
Pensacola	0.043	0.044	2.57	0.001	4
Charlotte	0.063	0.066	4.76	0.003	4
Millbrook	0.063	0.066	4.76	0.003	4
Broward	0.042	0.037	10.60	0.004	4
AIRS- Teco	0.063	0.066	4.76	0.003	4
AIRS- API	0.063	0.066	4.76	0.003	4

For SO_2, no absolute PD is within the 15 percent acceptance criteria. The absolute differences are around 0.001 ppm. In contrast, there were 98 PE's pairs (Fig 4) at this level and the average PD was 7 percent with a 0.0003 ppm difference. Data rounding could account for some differences.

For CO audit level 2, there was quite a spread of PDs across the trace gas sites tested; 3 that passed the 15 percent and 4 that did not. The CO PE (Fig 10) had 110 audit pairs (level 2) with an average PD of 14.7 percent so there does appear to be variability at this audit level. One would also suspect the lower audit level to be variable

For O_3, the audit levels were higher, mostly at level 4. All the NPAP results were within 15 percent. The PEs (Fig 2) did go down to level 3 (1,389 audit pairs) with very acceptable results.

At the trace gas level, there may be a significant difference in PD of the NPAP results that are delivered through-the-probe and sampling lines, versus the annual PEs that go to the back of the instruments. Therefore, annual PEs may require different acceptance criteria than the NPAP audits. Additional NPAP audit data are needed and further evaluation of this information is necessary.

Preliminary Evaluations

Based upon initial assessments of 1-point QC, annual PEs, and a small sampling of NPAP data, one might conclude that audit levels 3-10 for O_3, SO_2, and CO could be assessed using the current statistical evaluation, which uses a percent difference. There is not enough data for NO_2 to draw this conclusion.

It is realized that the statistics used for evaluation at the site/PQAO level, using the 90 percent (precision) and 95 percent (bias) confidence limits, as described in the CFR, would expand the precision and bias estimates beyond an average PD. However, the PD results at the level 3 concentrations for O_3, SO_2, and CO are low enough that the confidence limit based precision or bias estimates do not appear to cause a failure of the current acceptance criteria. The pooled simulations run for these three pollutants at level 3 (Tables 2, 3, and 4) tend to bear this out.

Next Steps

1-Point QC Checks

In general, it appears that the current concentration level requirements for the 1-point QC checks can be achieved at the lowest levels (0.01 ppm for O_3, SO_2, and NO_2, and 1 ppm for CO) with the exception of ozone where there was not sufficient data at audit level 2 (which covers the 0.01 ppm level). Monitoring organizations should be encouraged to attempt to audit at the lower levels if their routine ambient air data are measured at the lower levels. Since the CFR reported data quality objectives (DQOs) for precision and bias for the gaseous pollutants are derived from the 1-point QC checks, which are currently being achieved, we do not need to change the statistics in the CFR for this QC check.

Annual Performance Evaluations

For the PEs, there are little data at levels 1 and 2 (see Table 1). Based on limited information on level 2 from NPAP data and PE data, it appears that a ppb difference or some alternate statistic may need to be used. Based on the difference statistics shown in the figures above, EPA is proposing the use of the following acceptance criteria for levels 1 and 2 audit ranges:

- For O_3, SO_2, and NO_2: $\pm$ 1.5 ppb difference or $\pm$ 15 percent difference, whichever is greater.
- For CO: $\pm$ 0.03 ppm difference or $\pm$ 15 percent difference, whichever is greater.

As additional low-level audit data become available, OAQPS will work with the EPA Regions and monitoring organizations to review these results to determine the performance of the acceptance criteria described above.