AQS Report Documentation

Precision & Accuracy Criteria Pollutant
Quality Indicator Summary Data Extraction
(AMP255)

User Guide

Version 1

September 30, 2005

1 Background

1.1 Purpose

The Quality Indicator Summary Data Extraction, AMP255, provides statistical estimates of the precision, bias, and accuracy of monitors for criteria air pollutants, and it summarizes the completeness of monitor checks ("precision & accuracy data") from which the statistical estimates are derived. The module's primary purpose is to produce a set of Excel spreadsheets used by the Emissions, Monitoring, and Analysis Division of OAQPS to publish annual quality indicator reports for the criteria air pollutant monitoring network operated by state, local, and tribal agencies.

1.2 Assumptions

1.2.1 Operational Features

1. Like other AQS standard outputs, AMP255 output always includes a "cover page" that lists the criteria used for producing a particular report. The cover page lists all criteria that a user entered or selected, including default choices, on all tabs of the AQS Web Application standard reports interface for AMP255. For further information about cover page properties, refer to the requirements document for AMPCP.

2. The user interface for specifying AMP255 report criteria is the standard reports module (retrieval > standard report selection).

3. AMP255 produces data files ("work files") only. There is no formatted report, other than the cover page.

4. AMP255 output includes empty Excel spreadsheets configured to import data files produced AMP255. The spreadsheets include formatting and macros for displaying quality indicator summary data.

5. AMP255 uses standard AQS report output delivery features. All parts of the output—cover page, data files, empty spreadsheets—are delivered in a single compressed archive (.zip) file.

1.2.2 Data Selection

1. References to column name MONITOR_ID in this document should be interpreted to mean the equivalent column TRIBAL_MONITOR_ID when the operating mode is *tribal*. (Operating mode is discussed in section 2.1.)

2. AMP255 derives completeness, bias, and precision estimates from quality assurance data in AQS tables (ACCURACY_DATA, PRECISION_DATA, etc.), not from raw data in AQS.

3. A site's primary monitor is defined by information in the MONITOR_COLLOCATIONS table. If that information is absent, AMP255 assumes a site has no collocated monitors.

4. Completeness and precision estimates of collocation QC checks for PM2.5, PM10, and Pb pertain to the primary monitor at each site.

5. AMP255 ignores and omits collocated (duplicate) monitors that are so designated in the MONITOR_COLLOCATIONS table (column PRI_MONITOR_IND='N'). Collocated monitors do not count toward to total number of monitors for a reporting agency, and they are omitted from report output tables of flow rate checks.

1.3 Glossary

The following terms and acronyms are used in this document.

Accuracy – A measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and

systematic error (bias) components that are due to sampling and analytical operations. EPA now uses the terms "precision" and "bias" instead of "accuracy".

Audit – A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Bias – The systematic or persistent distortion of a measurement process, which causes errors in one direction.

CFR – *Code of Federal Regulations*, the official publication of federal government rules and regulations.

Collocated samples – Two or more portions collected at the same point in time and space so as to be considered identical.

Completeness – A measure of the amount of valid data obtained from a measurement system compared to the amount expected under correct, normal conditions.

Performance Evaluation (PE) check – A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Precision – A measure of mutual agreement among individual measurements of the same property, usually expressed in terms of the standard deviation.

Quality Control (QC) check (or Quality Check) – A type of audit to test the precision and bias of air pollution monitoring equipment. A *single-point* or *one-point* QC check involves one measurement of a standard sample whose properties have been determined by an authoritative source. (A PE check, on the other hand, usually includes measurements of several standard samples with different concentrations.) A *collocation* QC check involves a single pair of measurements by two samplers located close enough to each other that they effectively measure the same sample.

2 Data Selection and Output Options

This chapter describes the options available on each tab (form) of the AQS standard reports user interface.

2.1 Operating Mode

A user of AQS client software selects either *tribal* or *state-county* operating mode. (This selection is not in the AQS standard reports interface, but the selection affects how the standard reports interface operates and also what codes are used in AMP255 outputs.)

In tribal mode, geographic selection may be by Native American tribe code and/or state and county codes. AMP255 outputs for tribal monitoring sites contain geographic codes of the format TT*ttt*, where "TT" signifies a tribal-mode geographic code and *ttt* is a tribe code.

In state-county mode, geographic selection is by state and county codes; selection by Native American tribe code is not available. AMP255 outputs contain geographic codes of the format *ssccc*, where *ss* is FIPS state code and *ccc* is FIPS county code.

2.2 Criteria Set

Option	Description
Output delivery mode	Choose the option you prefer: *run online*, *send via email*, *send to CDX*. You will receive the same output files, regardless of the option you select.
Output type	Only the workfile option is available, and it is selected by default.
Output file name	When output delivery mode is *send via email* or *send to CDX*, a field is available for specifying the base file name of output files.
Default output file name	If output delivery mode is *run online*, or if you do not specify an output file name, a system-generated file name is used.

2.3 Area Selection / Monitor Selection

Option	Description
Geographic criteria	You may specify multiple combinations of *EPA region*, *state*, or *county*; or multiple *tribe* codes. No other geographic selection type is available.
Geographic criteria	At least one geographic selection is required.
Monitor type	One or more monitor types may be selected, but a selection is not required. If none is selected, the report includes all monitor types that are associated with the data selected by other criteria.
Reporting organization	One or more reporting organizations may be selected, but a selection is not required. If none is selected, the report includes all reporting organizations that are associated with the data selected by other criteria.
Pollutant type	Only one pollutant type is available: *criteria* pollutants. That choice must be selected in order to generate a report. (The user interface cannot provide a default selection.)
Parameter	One or more criteria pollutants may be selected, but a selection is not required. If none is selected, the report includes all criteria pollutants that are associated with the data selected by other criteria.
Parameter	Although TSP (suspended particulate, parameter code 11101) is included in the list of criteria pollutants, the report never includes data for that parameter.

Option	Description
Method	One or more sampling and analysis methods may be selected, but a selection is not required. If none is selected, the report includes all methods that are associated with the data selected by other criteria.
Method	Selecting a sampling and analysis method alone is not allowed; it must be specified in combination with a parameter. Multiple methods may be specified in combination with the same parameter, using multiple rows of the form
Date	The date range for a report is defined by a start year-quarter and an end year-quarter. The date range includes the first day of the start quarter through the last day of the end quarter. The date range must be entirely in the past; it may not include the current quarter or future quarters.
Date	All four parts of a date range—start year, start quarter, end year, end quarter—must be specified. There are no defaults.
Other	Only the selection criteria described above are available for use. All other selection criteria are hidden, and they are not available for use with this report.

2.4 Sort Order

Option	Description
No sort option	Outputs of this report have a fixed sort order that you cannot alter. The sort order tab indicates this restriction by displaying the same value for *Lo* and *Hi* sort range values within each row of the form.
Sort order	Report output is sorted in ascending order of the following fields (primary key listed first): 1. parameter code (pollutant) 2. EPA region code 3. state abbreviation ("TT" in tribal selection mode) 4. reporting agency code 5. monitor type group (NSP=1, other=2) 6. county code (tribal code in tribal selection mode) 7. site ID Date is not part of the sort order because the report aggregates data for the entire date range.
Multi-state reporting agencies	Data for a reporting agency having monitoring sites in multiple states are sorted as if EPA region code were "99" and state abbreviation were "ZZ". This device places multi-state reporting agencies last in each output file.

2.5 Report Options

Option	Description
Summary type	Four types of quality indicator summaries may be included in the report: • completeness (PE and QC checks) • precision and bias (QC checks) • accuracy (PE checks, gaseous pollutants only) • collocation (QC checks, particulates only) For each summary type there is a report option with a yes/no choice. The default choice is *yes*: include the summary type in report output. If the *no* choice is selected, data for that summary type is omitted from report output. (Not all summary types are applicable to all pollutants.)
Other	This report has no other report options. Common options such as *events processing* and *merge PDF files* are not applicable to this report and are not available.

3 Report Formats

3.1 *Report Summary Types*

All report tables give summaries by pollutant + reporting agency + monitor type group. Monitor type groups are NAMS-SLAMS-PAMS, and all other types. Monitor type *unofficial PAMS* is equivalent to *PAMS*, and is included in the NAMS-SLAMS-PAMS group.

All report tables but one (accuracy for gaseous pollutants) give summaries by pollutant + reporting agency + monitor type group + monitor. The first (or only) monitor for a site is identified by its site code. (*Site* is state code + county code + site ID or "TT" + tribal code + site ID.) Additional monitors for the site are identified by site code and POC (parameter occurrence code) joined by an underscore character: *site_poc*.

Report tables do **not** give summaries by date. A site summary or a monitor type group summary includes data for all dates within the report date range, whether the range is one quarter or multiple years.

Report tables contain only summary rows (monitor summary or agency/monitor type group summary). There are no "detail" rows.

3.2 *Printed Report Format*

This report has no printed report.

3.3 *Workfile Format*

This report produces comma-delimited text files (CSV files) of quality indicator summary data. Each file corresponds to a table (appendix) in the *2003 Criteria Pollutant Quality Indicator Summary Report*.

These attributes are common to all report tables (CSV files):

1. Each report table is produced as a comma-delimited text file (CSV file). Each file contains the data elements (columns) appropriate to the particular table. *Field Derivations*, Chapter 4 of this document, describes how column values are derived.

2. Each CSV file is paired with a template Excel worksheet. An Excel spreadsheet file (amp255.xls), which is included as part of the report output, automates the loading of CSV files into the appropriate worksheets when that file is opened in Excel software. The automated loading process is mediated by a macro specific to Excel software, and it may not work in other spreadsheet software. However, the CSV files are compatible with any spreadsheet software.

3. The report output includes a CSV file, designated with suffix "-0", that lists the pairings of CSV data files and template Excel worksheets. This file is primarily for use by the automated loading process, but it also serves as a description of the CSV files for those not using the automated process.

4. Every value in a CSV file is enclosed in double quotes ("value").

5. The first record of each file contains the table title, which describes the type of quality indicator data, names the pollutant, and gives the date range of the report.

6. The second record (row) of each CSV file lists the names of the data elements in the table (*i.e.*, column headings).

The following subsections illustrate each table format as it appears in Excel, and list the pollutants for which the table format is used.

3.3.1 Gaseous Pollutants QC Completeness Tables

There is a separate QC completeness table (file) for each gaseous pollutant:
- Table A – CO
- Table C – NO2
- Table E – O3
- Table G – SO2

All tables have the same format, as shown in the Table A example below. Each table is a worksheet (tab) in the template Excel workbook file, *Gaseous QI Completeness Tables.xls*.

Table A (example). Single Point Quality Check Completeness for CO, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	% Sites <50% Complete
1	CT	0251	SLAMS	090010004	1/1/2003	12/19/2003	25	21	84	NA
1	CT	0251	SLAMS	090010020	1/1/2003	12/31/2003	26	23	88	NA
1	CT	0251	SLAMS	090030017	1/1/2003	12/31/2003	26	23	88	NA
1	CT	0251	SLAMS	090031003	1/1/2003	12/31/2003	26	25	96	NA
1	CT	0251	SLAMS	090090025	1/1/2003	12/31/2003	26	23	88	NA
1	CT	0251	All - NSP	NA	NA	NA	129	115	89	0
1	MA	0660	SLAMS	250130016	1/1/2003	12/31/2003	26	26	100	NA
1	MA	0660	SLAMS	250132007	1/1/2003	2/28/2003	4	3	75	NA
1	MA	0660	SLAMS	250170007	1/1/2003	12/31/2003	26	24	92	NA
1	MA	0660	SLAMS	250250002	1/1/2003	12/31/2003	26	18	69	NA
1	MA	0660	SLAMS	250250042	1/1/2003	12/31/2003	26	25	96	NA
1	MA	0660	SLAMS	250270020	1/1/2003	9/30/2003	19	19	100	NA
1	MA	0660	All - NSP	NA	NA	NA	127	115	89	0
1	ME	0635	OTHER	230052003	1/1/2003	12/31/2003	26	21	81	NA
1	ME	0635	OTHER	230090102	1/1/2003	12/31/2003	26	20	77	NA
1	ME	0635	All - Other	NA	NA	NA	52	41	79	0

3.3.2 Gaseous Pollutants PE Completeness Tables

There is a separate PE completeness table (file) for each gaseous pollutant:
- Table B – CO
- Table D – NO2
- Table F – O3
- Table H – SO2

All tables have the same format, as shown in the Table D example below. Each table is a worksheet (tab) in the template Excel workbook file, *Gaseous QI Completeness Tables.xls*.

Table D (example). Performance Evaluation Check Completeness for NO2, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	Tot. # of Sites	Audits in Quarters 1/2/3/4
3	WV	0064	INDUSTRIAL	540990003	1/1/2003	12/31/2003	1(3)	0(0)	0%(0%)	NA	NA
3	WV	0064	All - Other	NA	NA	NA	4(12)	0(0)	0%(0%)	1	0/0/0/0
4	AL	1029	OTHER	010331002	1/1/2003	3/31/2003	1(3)	1(3)	100%(100%)	NA	NA
4	AL	1029	OTHER	010710020	1/1/2003	12/31/2003	1(3)	0(0)	0%(0%)	NA	NA
4	AL	1029	OTHER	010830004	4/1/2003	12/31/2003	1(3)	2(6)	100%(100%)	NA	NA
4	AL	1029	All - Other	NA	NA	NA	4(12)	3(9)	67%(67%)	3	1/1/1/0
4	FL	0121	SLAMS	120110031	1/1/2003	12/31/2003	1(3)	2(6)	100%(100%)	NA	NA
4	FL	0121	SLAMS	120118002	1/1/2003	12/31/2003	1(3)	2(6)	100%(100%)	NA	NA
4	FL	0121	All - NSP	NA	NA	NA	4(12)	4(12)	100%(100%)	2	1/1/1/1
4	FL	0274	SLAMS	120860027	1/1/2003	12/31/2003	1(3)	2(6)	100%(100%)	NA	NA
4	FL	0274	SLAMS	120864002	1/1/2003	12/31/2003	1(3)	2(6)	100%(100%)	NA	NA
4	FL	0274	All - NSP	NA	NA	NA	4(12)	4(12)	100%(100%)	2	1/1/1/1
4	FL	0392	SLAMS	121030018	1/1/2003	12/31/2003	1(3)	7(21)	100%(100%)	NA	NA
4	FL	0392	All - NSP	NA	NA	NA	4(12)	7(21)	100%(100%)	1	2/2/1/2
4	FL	0392	OTHER	120330004	1/1/2003	12/31/2003	1(3)	4(12)	100%(100%)	NA	NA
4	FL	0392	All - Other	NA	NA	NA	4(12)	4(12)	100%(100%)	1	1/1/1/1

3.3.3 Gaseous Pollutants QC Precision and Bias Tables

There is a separate QC precision and bias table (file) for each gaseous pollutant and monitor type group:
- Table I – CO (NSP group)
- Table K – CO (other group)
- Table O – NO2 (NSP group)
- Table Q – NO2 (other group)
- Table U – O3 (NSP group)
- Table W – O3 (other group)
- Table AA – SO2 (NSP group)
- Table CC – SO2 (other group)

All tables have the same format, as shown in the Table U example below. Each table is a worksheet (tab) in the template Excel workbook file, *Precision and Accuracy Tables.xls*.

Table U (example). Single Point Precision and Bias Estimates for O3 NSP Sites, year 2003.

Region	State	Agency	Site	CFR Lower Limit	CFR Upper Limit	Bias UB	CV UB
9	NV	1138	320310016	-5.72	6.42	1.67	2.09
9	NV	1138	320310020	-5.72	6.42	3.46	3.95
9	NV	1138	320310025	-5.72	6.42	3.21	3.90
9	NV	1138	320311005	-5.72	6.42	3.1	3.85
9	NV	1138	320312002	-5.72	6.42	3.52	3.43
9	NV	1138	320312009	-5.72	6.42	+3.43	3.25
9	NV	1138	All - NSP	-5.72	6.42	2.67	3.35
10	OR	0598	410391007	-1.04	1.82	0.65	0.91
10	OR	0598	All - NSP	-1.04	1.82	0.65	0.91
10	OR	0821	410050004	-8.33	7.65	3.65	3.69
10	OR	0821	410052002	-8.33	7.65	0.49	0.76
10	OR	0821	410090004	-8.33	7.65	2.18	3.19
10	OR	0821	410470004	-8.33	7.65	6.44	7.02
10	OR	0821	410510080	-8.33	7.65	-10.55	8.53
10	OR	0821	All - NSP	-8.33	7.65	3.3	4.75

3.3.4 Gaseous Pollutants PE Accuracy Tables

There is a separate PE accuracy table (file) for each gaseous pollutant and monitor type group:
- Table M – CO (NSP group)
- Table N – CO (other group)
- Table S – NO2 (NSP group)
- Table T – NO2 (other group)
- Table Y – O3 (NSP group)
- Table Z – O3 (other group)
- Table EE – SO2 (NSP group)
- Table FF – SO2 (other group)

All tables have the same format, as shown in the Table FF example below. Each table is a worksheet (tab) in the template Excel workbook file, *Precision and Accuracy Tables.xls*.

Table FF (example). Reporting Organization Accuracy Summary for SO2 Non-NSP Sites, year 2003.

Region	State	Agency	I	II	III	IV
1	CT	0251				
1	MA	0345				
1	ME	0635	(-13.8,+2.2)	(-4.7,-1.7)	(-6.8,-1.2)	
1	NH	0762	(-15.7,+11.6)	(-13.3,+11.7)	(-10.4,+10.1)	
2	NY	0768	(0,0)	(-1.6,-0.3)	(-2.5,+0.1)	
2	VI	1239	(-9.7,+2.3)	(-8.1,+2.3)	(-7.9,+2.8)	(-7.8,+2.5)
3	PA	0851	(-15.9,+13.1)	(-10.2,+8.8)	(-10.7,+9.4)	
3	VA	0745				
3	WV	0064				
4	AL	1029	(-9.0,-1.1)	(-1.4,+2.6)	(-1.1,+3.0)	(-0.6,+0.2)
4	FL	0491				
4	FL	0867	(-5.9,-3.7)	(-4.4,-2.7)	(-5.0,-2.4)	
4	KY	0584	(-13.6,+2.8)	(-10.7,+6.4)	(-9.5,+8.0)	
4	KY	1029				
4	NC	0776	(-11.3,+3.3)	(-11.5,+2.4)	(-10.8,+4.2)	

3.3.5 PM2.5 Collocation QC Completeness and Precision Table

This table (GG) summarizes the completeness and precision of collocation QC checks for PM2.5 monitors. Only the results of checks of collocated primary PM2.5 monitors are included in the table (file), which gives summaries by site and by monitor type group.

Table GG format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *PM2_5 Tables.xls*.

Table GG (example). PM2.5 Collocation Summaries, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	% Sites <50% Complete	Total # of Sites	No. of Sites Collocated	Site Comp %	Pairs > 6	CV UB	CV Est.
9	HI	0481	SLAMS	150031001	1/1/2003	12/31/2003	60	56	93	NA	NA	NA	NA	8	9.16	5.54
9	HI	0481	SLAMS	150032004	1/1/2003	12/31/2003	60	43	72	NA	NA	NA	NA	5	16.76	7.74
9	HI	0481	All - NS	NA	NA	NA	120	99	83	0	5	2	100	13	9.24	6.47

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date										
9	NV	0226	SLAMS	320030560	1/1/2003	12/31/2003	60	51	85	NA	NA	NA	NA	38	16.17	13.50
9	NV	0226	All - NS	NA	NA	NA	60	51	85	0	5	1	100	38	16.17	13.50
9	NV	1138	SLAMS	320310016	1/1/2003	12/31/2003	60	119	100	NA	NA	NA	NA	74	0.84	0.91
9	NV	1138	All - NS	NA	NA	NA	60	119	100	0	1	1	100	74	0.84	0.91
10	AK	0015	SLAMS	020200018	1/1/2003	12/31/2003	60	52	87	NA	NA	NA	NA	22	8.59	6.72
10	AK	0015	SLAMS	020900010	1/1/2003	12/31/2003	60	45	75	NA	NA	NA	NA	27	4.32	3.47
10	AK	0015	SLAMS	021100004	10/1/2003	12/31/2003	15	15	100	NA	NA	NA	NA	9	5.79	4.56
10	AK	0015	All - NS	NA	NA	NA	135	112	87	0	5	3	100	58	5.76	5.10
10	AK	0015	All - Other	NA	NA	NA	-	0	0	100	2	0	0	0		
10	ID	0182	TRIBAL MONITORS	160490003	1/1/2003	12/31/2003	60	55	92	NA	NA	NA	NA	37	2.57	2.27
10	ID	0182	All - Other	NA	NA	NA	60	55	92	0	3	1	100	37	2.57	2.27

3.3.6 PM2.5 Manual Samplers Quarterly Flow Rate Audit Table

This table (HH) summarizes the completeness of flow rate audits of manual PM2.5 monitors. The table (file) includes the results of checks of all PM2.5 monitors using manual samplers, both collocated and not, and gives summaries by site and by monitor type group.

Table HH format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *PM2_5 Tables.xls*.

Table HH (example). Manual PM2.5 Flow Rate Completeness, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	Total # of Sites	Audits in Quarters 1/2/3/4
9	HI	0481	SLAMS	150030010	1/1/2003	12/31/2003	4	3	75	NA	NA
9	HI	0481	SLAMS	150031001	1/1/2003	12/31/2003	4	3	75	NA	NA
9	HI	0481	SLAMS	150031004	1/1/2003	12/31/2003	4	3	75	NA	NA
9	HI	0481	SLAMS	150032004	1/1/2003	12/31/2003	4	3	75	NA	NA
9	HI	0481	SLAMS	150090006	1/1/2003	12/31/2003	4	3	75	NA	NA
9	HI	0481	All - NS	NA	NA	NA	20	15	75	5	5/0/5/5
9	NV	0226	SLAMS	320030022	1/1/2003	12/31/2003	4	0	0	NA	NA
9	NV	0226	SLAMS	320030298	1/1/2003	12/31/2003	4	0	0	NA	NA
9	NV	0226	SLAMS	320030560	1/1/2003	12/31/2003	4	0	0	NA	NA
9	NV	0226	SLAMS	320031019	1/1/2003	12/31/2003	4	0	0	NA	NA
9	NV	0226	SLAMS	320032002	1/1/2003	12/31/2003	4	0	0	NA	NA
9	NV	0226	All - NS	NA	NA	NA	20	0	0	5	0/0/0/0
9	NV	1138	SLAMS	320310016	1/1/2003	12/31/2003	4	3	75	NA	NA
9	NV	1138	All - NS	NA	NA	NA	4	3	75	1	1/1/0/1
10	AK	0015	SLAMS	020200018	1/1/2003	12/31/2003	4	7	100	NA	NA
10	AK	0015	SLAMS	020900010	1/1/2003	12/31/2003	4	6	100	NA	NA
10	AK	0015	SLAMS	021100004	10/1/2003	12/31/2003	1	1	100	NA	NA
10	AK	0015	SLAMS	021700008	1/1/2003	12/31/2003	4	7	100	NA	NA
10	AK	0015	SLAMS	022900003	1/1/2003	6/30/2003	2	2	100	NA	NA
10	AK	0015	All - NS	NA	NA	NA	15	23	100	5	6/9/4/4
10	AK	0015	UNKNOWN	021100026	1/1/2003	1/2/2003	1	0	0	NA	NA
10	AK	0015	SPECIAL PURPOSE	021100027	1/3/2003	6/30/2003	2	4	100	NA	NA
10	AK	0015	All - Other	NA	NA	NA	3	4	50	2	2/2/0/0

3.3.7 PM10 Automated Samplers Flow Rate QC Completeness Table

This table (II) summarizes the completeness of flow rate verification checks for automated PM10 monitors. The table (file) includes the results of checks of all automated PM10 monitors, both collocated and not, and gives summaries by site and by monitor type group.

Table II format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *PM10 Tables.xls*.

Table II (example). Automated PM10 Precision Completeness, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	% Sites <50% Complete
7	MO	0990	SLAMS	295100088	1/1/2003	12/31/2003	26	0	0	NA
7	MO	0990	All-NS	NA	NA	NA	26	0	0	100
7	MO	0990	OTHER	295100092	1/1/2003	12/31/2003	26	0	0	NA
7	MO	0990	All-Other	NA	NA	NA	26	0	0	100
8	CO	0240	SLAMS	080770014	1/1/2003	12/24/2003	25	22	88	NA
8	CO	0240	All-NS	NA	NA	NA	25	22	88	0
8	MT	0730	SLAMS	300290009	1/1/2003	12/31/2003	26	25	96	NA
8	MT	0730	SLAMS	300290047	1/1/2003	12/31/2003	26	22	85	NA
8	MT	0730	SLAMS	300530018	1/1/2003	12/31/2003	26	3	12	NA
8	MT	0730	SLAMS	300930005	1/1/2003	12/31/2003	26	11	42	NA
8	MT	0730	All-NS	NA	NA	NA	104	61	59	50
8	MT	1110	OTHER	300810006	1/1/2003	12/31/2003	26	16	62	NA
8	MT	1110	All-Other	NA	NA	NA	26	16	62	0

8	ND	0782	SLAMS	380130004	10/28/2003	12/31/2003	4	0	0	NA
8	ND	0782	All-NS	NA	NA	NA	4	0	0	100
8	SD	0973	SLAMS	460990007	1/1/2003	12/31/2003	26	20	77	NA
8	SD	0973	SLAMS	461030020	10/7/2003	12/31/2003	6	13	100	NA
8	SD	0973	All-NS	NA	NA	NA	32	33	89	0

3.3.8 PM10 Annual Flow Rate Audit Completeness Tables

These two tables—for automated samplers (Table JJ) and manual samplers (Table LL)—summarize the completeness of flow rate audits of PM10 monitors. The tables (files) include the results of checks of all PM10 monitors, both collocated and not, and give summaries by site and by monitor type group.

Both tables have the same format, as shown in the Table LL example below. The tables are worksheets (tabs) in the template Excel workbook file, *PM10 Tables.xls*.

Table LL (example). Manual PM10 Accuracy Completeness, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	Total # of Sites	Audits in Quarters 1/2/3/4
1	MA	0660	OTHER	250132009	1/1/2003	1/15/2003	1	0	0	NA	NA
1	MA	0660	OTHER	250250027	4/9/2003	12/31/2003	1	0	0	NA	NA
1	MA	0660	OTHER	250270020	1/1/2003	9/30/2003	1	0	0	NA	NA
1	MA	0660	All-Other	NA	NA	NA	4	0	0	3	0/0/0/0
1	ME	0314	SLAMS	230132001	1/1/2003	12/31/2003	1	9	100	NA	NA
1	ME	0314	All-NS	NA	NA	NA	4	9	100	1	3/2/2/2
1	ME	0635	SLAMS	230010011	1/1/2003	12/29/2003	1	4	100	NA	NA
1	ME	0635	SLAMS	230050027	1/1/2003	12/31/2003	1	4	100	NA	NA
1	ME	0635	SLAMS	230110016	1/1/2003	12/29/2003	1	4	100	NA	NA
1	ME	0635	SLAMS	230172007	1/1/2003	12/31/2003	1	8	100	NA	NA
1	ME	0635	SLAMS	230190002	1/1/2003	12/29/2003	1	3	100	NA	NA
1	ME	0635	All-NS	NA	NA	NA	5	23	100	5	6/5/6/6
1	ME	0635	OTHER	230030013	1/1/2003	12/31/2003	1	0	0	NA	NA
1	ME	0635	OTHER	230031008	1/1/2003	12/31/2003	1	3	100	NA	NA
1	ME	0635	OTHER	230031016	1/1/2003	5/30/2003	1	0	0	NA	NA
1	ME	0635	OTHER	230031018	1/1/2003	12/31/2003	1	2	100	NA	NA
1	ME	0635	OTHER	230050002	1/1/2003	12/31/2003	1	4	100	NA	NA
1	ME	0635	INDUSTRIAL	230070003	1/1/2003	12/31/2003	1	2	100	NA	NA
1	ME	0635	OTHER	230090103	9/1/2003	10/16/2003	1	XX	XX	NA	NA
1	ME	0635	All-Other	NA	NA	NA	7	11	57	7	1/4/4/2

3.3.9 PM10 Manual Samplers Collocation QC Completeness and Precision Table

This table (KK) summarizes the completeness and precision of collocation QC checks for collocated PM10 manual samplers. Only the results of checks of collocated primary PM10 monitors are included in the table (file), which gives summaries by site and by monitor type group.

Table KK format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *PM10 Tables.xls*.

Table KK (example). Manual PM10 Precision, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	% Sites <50% Complete	Total # of Sites	No. of Sites Collocated	Site Comp %	Number > 20	CV UB	Lower 95% Prob. Limit	Upper 95% Prob. Limit
1	CT	0251	SLAMS	090032006	1/1/2003	12/31/2003	60	2	3	NA	NA	NA	NA	0	.	.	.
1	CT	0251	SLAMS	090091123	1/1/2003	12/31/2003	60	2	3	NA	NA	NA	NA	1	.	.	.
1	CT	0251	SLAMS	090092123	1/1/2003	12/31/2003	60	61	100	NA	NA	NA	NA	27	4.7	-13.0	6.6
1	CT	0251	All-NS	NA	NA	NA	180	65	36	67	12	3	100	28	4.6	-12.8	6.6
1	CT	0251	All-Other	NA	NA	NA	.	.	.	0	1	0	0	.	.	.	.
1	MA	0660	SLAMS	250250002	4/1/2003	12/29/2003	45	36	80	NA	NA	NA	NA	2	584.7	-45.9	97.8
1	MA	0660	SLAMS	250250042	10/12/2003	12/31/2003	13	14	100	NA	NA	NA	NA	5	13.2	-6.4	21.1
1	MA	0660	All-NS	NA	NA	NA	58	50	90	0	3	2	100	7	26.9	-23.4	48.8
1	MA	0660	OTHER	250250027	4/9/2003	12/31/2003	44	25	57	NA	NA	NA	NA	9	9.1	-13.7	14.0
1	MA	0660	All-Other	NA	NA	NA	44	25	57	0	3	1	100	9	9.1	-13.7	14.0
1	ME	0314	SLAMS	230132001	1/1/2003	12/31/2003	60	60	100	NA	NA	NA	NA	12	11.9	-22.3	18.3
1	ME	0314	All-NS	NA	NA	NA	60	60	100	0	1	1	100	12	11.9	-22.3	18.3
1	ME	0528	SLAMS	230070004	1/1/2003	12/31/2003	60	59	98	NA	NA	NA	NA	9	2.8	-3.9	4.6
1	ME	0528	All-NS	NA	NA	NA	60	59	98	0	1	1	100	9	2.8	-3.9	4.6
1	ME	0635	SLAMS	230172007	1/1/2003	12/31/2003	60	55	92	NA	NA	NA	NA	8	2.2	-3.8	2.6
1	ME	0635	All-NS	NA	NA	NA	60	55	92	0	5	1	100	8	2.2	-3.8	2.6
1	ME	0635	OTHER	230090103	9/1/2003	10/16/2003	7	XX	XX	NA	NA	NA	NA	.	.	.	.
1	ME	0635	All-Other	NA	NA	NA	.	.	.	0	7	0	0	.	.	.	.
1	NH	0762	All-NS	NA	NA	NA	.	.	.	0	7	0	0	.	.	.	.
1	NH	0762	OTHER	330110020	1/1/2003	12/31/2003	60	61	100	NA	NA	NA	NA	17	14	-20.5	32.6

| 1 | NH | 0762 | All-Other | NA | NA | NA | 60 | 61 | 100 | 0 | 1 | 1 | 100 | 17 | 14 | -20.5 | 32.6 |

3.3.10 Lead Collocation QC Completeness Table

This table (MM) summarizes the completeness of flow rate QC checks for collocated samplers that collect lead data. Only the results of checks of collocated primary Pb monitors are included in the table (file), which gives summaries by site and by monitor type group.

Table MM format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *Lead Tables.xls*.

Table MM (example). Pb Collocation Completeness, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	% Sites <50% Complete	Total # of Sites	No. of Sites Collocated	Site Comp %
6	OK	1249	TRIBAL MONITORS	401159005	10/1/2003	12/31/2003	15	26	100	NA	NA	NA	NA
6	OK	1249	All - Other	NA	NA	NA	15	26	100	0	4	1	100
6	TX	0196	All - NS	NA	NA	NA	-	0	0	100	2	0	0
6	TX	0196	All - Other	NA	NA	NA	-	0	0	100	3	0	0
6	TX	0335	SLAMS	481410002	1/1/2003	6/1/2003	25	10	40	NA	NA	NA	NA
6	TX	0335	All - NS	NA	NA	NA	25	10	40	100	2	1	100
6	TX	1035	SLAMS	480850007	1/1/2003	12/31/2003	60	37	62	NA	NA	NA	NA
6	TX	1035	All - NS	NA	NA	NA	60	37	62	0	2	1	100
6	TX	1035	All - Other	NA	NA	NA	-	0	0	100	5	0	0

3.3.11 Lead Annual Flow Rate Audit Completeness Table

This table (NN) summarizes the completeness of flow rate audits of lead monitors. The table (file) includes the results of checks of all samplers that collect lead data (TSP, PM10, etc.). The table summarizes completeness of the checks by site and by monitor type group.

Table NN format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *Lead Tables.xls*.

Table NN (example). Pb Flow Rate Completeness, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Number Required	Number Submitted	% Complete	Total # of Sites	Audits in Quarters 1/2/3/4
6	OK	1249	TRIBAL MONITORS	401159005	10/1/2003	12/31/2003	1	0	0	NA	NA
6	OK	1249	TRIBAL MONITORS	401159006	10/1/2003	12/31/2003	1	0	0	NA	NA
6	OK	1249	TRIBAL MONITORS	401159007	10/1/2003	12/31/2003	1	0	0	NA	NA
6	OK	1249	TRIBAL MONITORS	401159008	10/1/2003	12/31/2003	1	0	0	NA	NA
6	OK	1249	All - Other	NA	NA	NA	4	0	0	4	0/0/0/0
6	TX	0196	SLAMS	481130018	1/1/2003	12/31/2003	1	3	100	NA	NA
6	TX	0196	SLAMS	481130057	1/1/2003	12/31/2003	1	15	100	NA	NA
6	TX	0196	All - NS	NA	NA	NA	4	18	100	2	6/6/0/6
6	TX	0196	OTHER	481130056	1/1/2003	12/31/2003	1	0	0	NA	NA
6	TX	0196	OTHER	481130061	1/1/2003	3/1/2003	1	0	0	NA	NA
6	TX	0196	OTHER	481130066	1/1/2003	12/31/2003	1	4	100	NA	NA
6	TX	0196	All - Other	NA	NA	NA	4	4	33	3	1/1/1/1

3.3.12 Lead PE Check Completeness Table

This table (OO) summarizes the completeness of quarterly performance evaluation checks for lead monitors. The checks use filter strips containing known lead concentrations to measure the accuracy of laboratories performing analyses for lead. The table (file) summarizes completeness of the checks by site and by monitor type group.

Table OO format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *Lead Tables.xls*.

Table OO (example). Pb Filter Strip Completeness, year 2003.

Region	State	Reporting Agency	Monitor Type	Site ID	Start Date	End Date	Audits Required (Level 1)	Audits Submitted (Level 1)	% Complete (Level 1)	Audits Required (Level 2)	Audits Submitted (Level 2)	% Complete (Level 2)
3	PA	0851	OTHER	420111717	1/1/2003	12/31/2003	12	0	0	12	15	100
3	PA	0851	OTHER	420450002	1/1/2003	12/31/2003	12	0	0	12	0	0
3	PA	0851	OTHER	421290007	1/1/2003	12/31/2003	12	0	0	12	0	0
3	PA	0851	All - Other	NA	NA	NA	36	0	0	36	15	33
3	PA	0861	SLAMS	421010049	1/1/2003	12/31/2003	12	0	0	12	0	0
3	PA	0861	SLAMS	421010449	1/1/2003	12/31/2003	12	10	83	12	10	83

3	PA	0861	All - NS	NA	NA	NA	24	10	42	24	10	42
4	AL	0013	SLAMS	011090003	1/1/2003	12/31/2003	12	0	0	12	0	0
4	AL	0013	All - NS	NA	NA	NA	12	0	0	12	0	0
4	AL	0013	OTHER	011090006	1/1/2003	12/31/2003	12	0	0	12	0	0
4	AL	0013	All - Other	NA	NA	NA	12	0	0	12	0	0
4	FL	0491	SLAMS	120571066	1/1/2003	12/31/2003	12	12	100	12	12	100
4	FL	0491	All - NS	NA	NA	NA	12	12	100	12	12	100
4	FL	0491	OTHER	120571073	1/1/2003	12/31/2003	12	0	0	12	0	0
4	FL	0491	All - Other	NA	NA	NA	12	0	0	12	0	0
4	FL	0867	SLAMS	121033005	1/1/2003	12/31/2003	12	12	100	12	12	100
4	FL	0867	All - NS	NA	NA	NA	12	12	100	12	12	100

3.3.13   Reporting Agency Table

This table (PP) gives the names of reporting agencies whose codes are listed in tables of quality indicator data.

Table PP format is shown in the example below. The table is a worksheet (tab) in the template Excel workbook file, *Reporting Agencies.xls*.

Table PP (example). Reporting Agencies, year 2003.

Region	State	Reporting Agency	Reporting Agency Name
1	Multiple	0762	New Hampshire Air Resources Agency
3	PA	0851	Pennsylvania Department Of Environmental Protection
3	PA	0861	Philadelphia Air Management Services
4	AL	0013	Al Dept Of Env Mgt
4	FL	0491	Hillsborough County Environmental Protection Commission
4	FL	0867	Pinellas County Department Of Environmental Management
Multiple	Multiple	0745	National Park Service

4   Field Derivations

This chapter describes the database sources and calculation methods of values in AMP255 output files.

4.1 Common Fields

These fields (report columns) occur in multiple tables.

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev. or "Multiple" for a multi-state agency summary
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	"Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types. See section 4.1.1
Site ID	SITES, MONITORS	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	Value is "NA" for group summaries. See section 4.1.2.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.

4.1.1 Monitor Type

There are two groups of monitor types:
- NAMS, SLAMS, PAMS, UNOFFICIAL PAMS (called "NAMS/SLAMS/PAMS", "NSP" or "NS")
- All other types (called "other" or "non-NSP" or "non-NS")

4.1.1.1   For a Site
If a monitor has multiple monitor type assignments in the NAMS/SLAMS/PAMS group, AMP255 lists the "highest" type in the order PAMS (highest), unofficial PAMS, SLAMS, NAMS (lowest).

If a monitor has multiple monitor types in the "other" group, AMP255 lists the type most recently assigned: max(MONITOR_TYPE_ASSIGNMENTS.MONITOR_TYPE_BEGIN_DATE.

4.1.1.2   For a Monitor Type Group
The name of the NAMS/SLAMS/PAMS group of monitor types is listed as:
- *All - NSP* if the PAMS monitor type is valid for the pollutant being summarized

- *All - NS* if the PAMS monitor type is not valid for the pollutant being summarized

The name of the "other" group of monitor types is listed as:

- *All - Other*

4.1.2 Site ID

The AQS operating mode (state-county or tribal) in effect when AMP255 runs determines the format of site IDs in AMP255 output files.

In state-county mode, a site ID value has the format **ssccciiii**, where *ss* and *ccc* and FIPS state and county codes, and *iiii* is AQS site ID code.

In tribal mode, a tribal site ID has the format **TTttttiiii**, where "TT" indicates tribal mode, *ttt* is an AQS tribal code, and *iiii* is AQS site ID code. A non-tribal site is displayed in state-county format.

AMP255 lists the site ID for each monitor in the report. If the report includes more than one monitor for the same site, pollutant, and monitor type group, AMP255 appends POC (parameter occurrence code) to site ID for each monitor after the first. The first monitor of a site is the one having the lowest POC value.

4.1.3 Start Date

AMP255 chooses a monitor's start date as the latest of:

- sampling begin date
- reporting agency begin date
- earliest begin date of monitor type assignments in a monitor type group
- beginning of the monitoring season
- beginning of the date range selected for the report

If a monitor had multiple disjoint periods of activity during the report date range, AMP255 lists "Multiple" as the value for start date. Disjoint periods, which are separated by more than one day, may be due to gaps between monitoring seasons, sampling periods, or monitor type assignments. Disjoint periods are primarily a concern for carbon monoxide monitors, which may have an October-March monitoring season. (Agencies currently define a "virtual" monitoring season with sampling periods, as no "official" monitoring seasons are defined for carbon monoxide monitoring.) For these monitors, AMP255 considers data only for the active periods, and lists the start date as "Multiple".

Start date is applicable to monitors only. AMP255 lists "NA" (not applicable) as the value of start date in table rows that pertain to monitor type group summaries.

4.1.4 End Date

AMP255 chooses a monitor's end dateas the earliest of:

- sampling end date
- reporting agency end date
- latest monitor type end date of monitor type assignments in the monitor type group
- end of the monitoring season
- end of the date range selected for the report

If a monitor had multiple disjoint periods of activity during the report date range, AMP255 lists "Multiple" as the value for end date. Disjoint periods, which are separated by more than one day, may be due to gaps between monitoring seasons, sampling periods, or monitor type assignments.

End date is applicable to monitors only. AMP255 lists "NA" (not applicable) as the value of end date in table rows that pertain to monitor type group summaries.

4.1.5 Percent Complete

Percent completeness values are displayed with no decimal places.

4.1.5.1   For a Site

Completeness of single point QC checks or PE checks for a site is the percentage of required checks that were submitted. If the number of checks submitted exceeds the number required, completeness is set to 100%.

$$Percent\ Complete_{Site} = \text{round}\left(100 * \min\left(1, \frac{Number\ Submitted_{Site}}{Number\ Required_{Site}}\right), 0\right) \tag{1}$$

4.1.5.2   For a Monitor Type Group

Completeness of QC or PE checks for a monitor type group is the average completeness of the *n* sites in the group.

$$Percent\ Complete_{Group} = \text{round}\left(\frac{\sum_{i=1}^{n}\left(Percent\ Complete_{Site}\right)_i}{n}, 0\right) \tag{2}$$

4.2 Gaseous Pollutants QC Completeness

The AMP255 output table summarizing completeness of single point QC checks for each gaseous pollutant (CO, NO2, O3, SO2) includes the fields (report columns) listed in the following table.

The table title is *Single Point Quality Check Completeness for* [pollutant], [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	"Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types. See section 4.1.1
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	Value is "NA" for group summaries. See section 4.1.2
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per monitor per 2 weeks	See section 4.2.1.
Number Submitted	PRECISION_DATA, QA_DETAILS	Calculated: Count of PRECISION_DATA dates	Count of distinct dates of QC checks in the report date range. See section 4.2.2.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
% Sites <50%	n/a	Calculated as percent: (number sites ≤50% complete) / (number of sites)	See section 4.2.3.

4.2.1 Number of QC Checks Required

One single point QC check is required at a monitor every two weeks. AMP255 calculates the number of checks required based on monitor start-end dates.

4.2.1.1   For a Site
The number of single point QC checks required per monitor is the number of complete 2-week intervals during which the monitor was in operation.

$$Number\ Required\ QC_{Site} = \text{floor}\left(\frac{(End\ Date - Start\ Date + 1)}{14}\right) \tag{3}$$

4.2.1.2   For a Monitor Type Group

The number of single point QC checks required per monitor type group per year is the sum of the number required by the monitors that comprise the group.

$$Number\ Required\ QC_{Group} = \sum_{i=1}^{n}\left(Number\ Required\ QC_{Site}\right)_i \tag{4}$$

where n is the number of monitors in a monitor type group.

4.2.2 Number of QC Checks Submitted

4.2.2.1   For a Site

The number of single point QC checks submitted per monitor is the number of distinct dates (PRECISION_DATA.PREC_DATE) on which analytical QC checks were performed for the monitor during the time period of the report.

$$Number\ Submitted\ QC_{Site} = \text{count}\left(\text{distinct } Date\ Check\ Performed\right) \tag{5}$$

If multiple single point QC checks were submitted for the same date, AMP255 uses all of them to calculate statistical estimates of precision and bias for the monitor (see section 4.4). For completeness, however, multiple QC checks on one date count as one check submitted.

4.2.2.2   For a Monitor Type Group

The number of single point QC checks submitted per monitor type group is the sum of the number submitted by the monitors that comprise the group.

$$Number\ Submitted\ QC_{Group} = \sum_{Sites} Number\ Submitted\ QC_{Site} \tag{6}$$

If multiple single point QC checks were submitted for the same date, AMP255 uses all of them to calculate statistical estimates of precision and bias for the monitor type group (see section 4.4). For completeness, however, multiple QC checks on one date count as one check submitted.

4.2.3 Percent of Sites Submitting Half or Less of Required QC Checks

The percentage of monitors that submitted half or less of required single point QC checks during the time period of the report is calculated for monitor type groups but not for monitors.

$$Percent\ Sites \le 50\% = 100 * \frac{\text{count}\left(Percent\ Complete_{Site} \le 50\%\right)}{\text{count}\left(Monitors\ in\ group\right)} \tag{7}$$

4.3 Gaseous Pollutants PE Completeness

The AMP255 output table summarizing completeness of performance evaluation (PE) checks for each gaseous pollutant (CO, NO2, O3, SO2) includes the fields (report columns) listed in the following table.

The table title is *Performance Evaluation Check Completeness for* [pollutant], [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated: 1 per site, 4 per group	See section 4.3.1. Two values are listed, in this format: #checks(#audits).
Number Submitted	ACCURACY_DATA, ACCURACY_AUDITS, AUDIT_LEVELS, QA_DETAILS	Calculated: count ACCURACY_DATA dates and count ACCURACY_AUDITS rows	See section 4.3.2. Two values are listed, in this format: #checks(#audits).
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5. Two values are listed, in this format: %checks(%audits).
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	See section 4.3.3. Value is "NA" for sites.
Audits in Quarters 1/2/3/4	ACCURACY_DATA, ACCURACY_AUDITS, AUDIT_LEVELS, QA_DETAILS	Calculated: count ACCURACY_DATA dates	See section 4.3.2. Four quarterly counts are listed, in this format: Q1/Q2/Q3/Q4. Value is "NA" for sites.

4.3.1 Number of PE Checks and Audits Required

Each monitor must have at least one PE check per year, and each reporting agency must conduct at least one PE check per quarter for each monitor type group. If an agency has fewer than four monitors in a monitor type group, it must conduct multiple PE checks of monitors in the group in order to satisfy the one-check-per-quarter requirement.

A PE check must include an audit (a determination of measurement accuracy) in each of three ranges of pollutant concentration (levels 1, 2, and 3). Thus each PE check should include three audits.

AMP255 lists both the checks and the audits required as one combined value (or, both values are listed in one column) with this format:

> number of PE checks required(number of PE audits required)

4.3.1.1 For a Site
One PE check, consisting of three audits, is required per monitor per year.

$$Number\ PE\ Checks\ Required_{Site} = \text{ceil}\left(\frac{quarters\ in\ report\ date\ range}{4}\right) \qquad (8)$$

$$Number\ PE\ Audits\ Required_{Site} = 3 * Number\ PE\ Checks\ Required_{Site} \qquad (9)$$

4.3.1.2 For a Monitor Type Group
One PE check per site per year or one PE check per calendar quarter (which ever is larger) is required per monitor type group per agency. Three PE audits are required per PE check.

$$Number\ PE\ Checks\ Required_{Group} = \max\left(\begin{array}{c} quarters\ in\ report\ date\ range, \\ \sum_{Sites} Number\ PE\ Checks\ Required_{Site} \end{array}\right) (10)$$

$$Number\ PE\ Audits\ Required_{Group} = 3 * Number\ PE\ Checks\ Required_{Group} \qquad (11)$$

4.3.2 Number of PE Checks and Audits Submitted

This value is the number of PE checks and audits reported to AQS, for the time period of the report, by a monitor or a monitor type group. AMP255 lists both the checks and the audits as one combined value (or, both values are listed in one column) with this format:

> number of PE checks submitted(number of PE audits submitted)

4.3.2.1 For a Site
The number of PE checks performed (submitted) for a monitor is the number of distinct dates (ACCURACY_DATA.ACC_DATE) on which PE checks were performed for that monitor during the time period of the report. If multiple PE checks were submitted for the same date, AMP255 uses all of them to calculate statistical estimates of accuracy for the monitor (see section 4.4). For completeness, however, multiple PE checks on one date count as one check submitted.

For each PE check, represented by a row of table ACCURACY_DATA, there are linked (related) rows in tables ACCURACY_AUDITS, AUDIT_LEVELS, and QA_DETAILS. The number of related ACCURACY_AUDITS rows is the number of audits associated with a PE check, and the related AUDIT_LEVELS rows give the concentration range of each audit. The related QA_DETAILS rows give the indicated and actual concentration values of each audit.

$$Number\ PE\ Checks\ Submitted_{Site} = \text{count}\left(\text{distinct } Date\ Check\ Performed\right) \qquad (12)$$

$$Number\ PE\ Audits\ Submitted_{Site} = \text{count}\left(ACCURACY\_AUDITS\ \text{rows}\right) \qquad (13)$$

The pertinent rows of table ACCURACY_DATA are selected with these conditions:

- ACC_DATE within the range *Start Date* through *End Date*
- AUC_AUDIT_CLASS = 'ANALYTICAL'
- ACT_ACC_TYPE = 'PE'

4.3.2.2   For a Monitor Type Group

The number of PE checks and audits submitted for a monitor type group is the sum of the corresponding counts for the monitors that comprise the monitor type group.

$$Number\ PE\ Checks\ Submitted_{Group} = \sum_{Sites} Number\ PE\ Checks\ Submitted_{Site} \qquad (14)$$

$$Number\ PE\ Audits\ Submitted_{Group} = \sum_{Sites} Number\ PE\ Audits\ Submitted_{Site} \qquad (15)$$

4.3.3 Total Number of Sites

This value is a count of all monitors for the gaseous pollutant that were active during any part of the time period of the report. An "active" monitor is one that has a sampling period (in table SAMPLE_PERIODS) within any part of the report time period.

The value is calculated for monitor type groups, but not for sites. (The value is "NA" for sites.)

4.3.4 Number of Audits by Quarter

The column labeled *Audits in Quarters 1/2/3/4* lists the number of PE analytical checks submitted in each calendar quarter for a monitor type group. (For a site, the value is "NA".) The four quarterly counts are separated by slashes:

$$AuditCount_{Q1}/AuditCount_{Q2}/AuditCount_{Q3}/AuditCount_{Q4}$$

The number of "audits" in a quarter is the number of distinct dates on which PE checks were performed by monitors comprising the monitor type group. For example, the number of PE checks in the first quarter is the number of distinct dates (ACC_DATE) in ACCURACY_DATA rows having QTR_REPRESENTED=1. The sum of the four quarterly counts is the total number of PE checks submitted for the monitor type group (section 4.3.2.2).

Audits in Quarters 1/2/3/4 consists of four counts, regardless of the time period of the report. If the time period is less than one year, counts for the excluded quarters are zero. If the report time period is more than one year, the counts for some quarters include audits submitted in multiple years. For example, if the report time period were 2003-Q1 through 2004-Q2, the audit counts for quarters 1 and 2 would be totals of 2003 and 2004 audits, while the audit counts for quarters 3 and 4 would represent 2003 audits only.

4.4 Gaseous Pollutants QC Precision and Bias

The AMP255 output tables that summarize statistical estimates of precision and bias of QC checks for gaseous pollutants (CO, NO2, O3, SO2) include the fields (report columns) listed in the following table. AMP255 generates two separate tables for each pollutant: a table for sites having monitors in the PAMS-NAMS-SLAMS monitor type group ("NSP"), and a table for sites having monitors in the "other" monitor type group ("Non-NSP"). Both tables have the same format.

The table titles are
- *Single Point Precision and Bias Estimates for* [pollutant] *NSP Sites,* [date range]
- *Single Point Precision and Bias Estimates for* [pollutant] *Non-NSP Sites,* [date range]

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Site ID	SITES	CC_CN_STT_STATE_CODE ‖ CC_CN_COUNTY_CODE ‖ SITE_ID or "TT" ‖ TA_TRIBAL_CODE ‖ SITE_ID	Value is "All - NSP" or "All - Other" for group summaries. See section 4.1.2.
CFR Lower Limit	n/a	Calculated. See section 4.4.2.	Value is "NA" for site summaries.
CFR Upper Limit	n/a	Calculated. See section 4.4.2.	Value is "NA" for site summaries.
Bias Upper Bound	n/a	Calculated. See section 4.4.3.	
CV Upper Bound	n/a	Calculated. See section 4.4.4.	

4.4.1 Relative Percent Difference

Statistical estimates in the precision and bias table—CFR probability limits, bias, and coefficient of variation—are based on the *relative percent difference* values calculated from single point QC checks. Relative percent difference expresses the difference between the pollutant concentration indicated by monitoring equipment and the known concentration of the sample used in the check.

AQS software calculates relative percent difference for each single point QC check from the indicated and actual value pairs in table QA_DETAILS. Relative percent difference is calculated as:

$$d = 100 * \frac{(ind - act)}{act} \tag{16}$$

where *d* is relative percent difference, *ind* is the indicated value, and *act* is the actual value.

NOTE: The following range check is **not** performed by AMP255, but it may be added in a future version.

AMP255 omits a relative percent difference value if neither the indicated nor the actual value from which it was calculated is within the concentration range specified by the CFR. Table 1 lists the allowed concentration range of QC checks for each gaseous pollutant. To perform a range check, AMP255 rounds indicated and actual values to the same number of decimal places as the applicable range limits shown in the table.

Table 1. CFR Concentration Ranges for Single Point QC Checks of Gaseous Pollutants

Pollutant	Allowed Concentration Range for Single Point QC Checks (PPM)
CO	8-10
NO_2	0.08-0.10
O_3	0.08-0.10
SO_2	0.08-0.10

4.4.2 CFR Lower and Upper 95% Probability Limits

Two table columns, *CFR Lower Limit* and *CFR Upper Limit*, give the 95% probability limits of relative percent difference values for the time period of an AMP255 report. (The column names are a reference to the regulation in 40 CFR Chapter 1 Part 58 Appendix A Section 5 that specifies a 95% probability interval.) The probability limits are calculated for each monitor type group, but not for monitors. In table rows for monitor summaries, the value of these two columns is "NA".

AMP255 calculates the upper and lower 95% probability limits as:

$$CFR\,Upper\,Probability\,Limit = D + (1.96 * S)$$
$$CFR\,Lower\,Probability\,Limit = D - (1.96 * S)$$

(17)

where *D* and *S* are the mean and standard deviation of relative percent difference for the monitor type group, calculated from the group's *n* single point QC checks as:

$$D = \frac{1}{n}\sum_{i=1}^{n} d_i$$

(18)

$$S = \sqrt{\frac{\left(n * \sum_{i=1}^{n} d_i^{\,2}\right) - \left(\sum_{i=1}^{n} d_i\right)^2}{n * (n-1)}}$$

(19)

Note that the *n* in these equations is the total number of QC checks submitted, rather than the number of dates of QC checks (section 4.2.2) used for calculating completeness.

Lower and upper limit values are displayed with leading sign (+ or -) and two decimal places.

4.4.3 Absolute Bias Upper Bound

The table column *Bias Upper Bound* is the 95% confidence upper limit of the mean of absolute values of relative percent difference for the time period of an AMP255 report. An estimate of absolute bias upper bound is calculated for each monitor and monitor type group. That is, absolute bias upper bound is calculated for each monitor's QC results, for the pooled QC results of a reporting agency's PAMS-NAMS-SLAMS monitors, and for the pooled QC results of the agency's "other" monitors.

AMP255 calculates absolute bias upper bound as:

$$|bias| = D_a + \left(t_{0.95,n-1} * S_a / \sqrt{n}\right)$$

(20)

where D_a and S_a are the mean and standard deviation of the absolute values of relative percent difference, calculated from a monitor's or group's *n* single point QC checks as:

$$D_a = \frac{1}{n} \sum_{i=1}^{n} |d_i| \tag{21}$$

$$S_a = \sqrt{\frac{\left(n * \sum_{i=1}^{n} |d_i|^2\right) - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n * (n-1)}} \tag{22}$$

The term $t_{0.95,n-1}$ in the |bias| equation is the 0.95 quantile of a t-distribution (that is, the "upper critical value" of a one-tailed distribution at probability=1-α=0.95) with n-1 degrees of freedom. The value of $t_{0.95,n-1}$ is obtained from AQS function *student_t_inv_prob*, which calculates the distribution value for a specified probability and degrees of freedom. The n in these equations is the total number of QC checks submitted, rather than the number of dates of QC checks (section 4.2.2) used for calculating completeness.

Absolute bias upper bound values are displayed with two decimal places, and may have a leading sign (+ or -). If the 25th and 75th percentile values of relative percent difference for a site or group have the same sign, absolute bias upper bound has a leading sign. The leading sign is the same as the sign of the percentile values. If the 25th and 75th percentiles of relative percent difference have opposite signs, or if both are zero, absolute bias has no leading sign.

4.4.4 Coefficient of Variation Upper Bound

The table column *CV Upper Bound* is the 90% confidence upper limit of the coefficient of variation of relative percent difference values for the time period of an AMP255 report. An estimate of coefficient of variation upper bound is calculated for each monitor and monitor type group. That is, an upper bound estimate is calculated for each monitor's QC results, for the pooled QC results of a reporting agency's PAMS-NAMS-SLAMS monitors, and for the pooled QC results of the agency's "other" monitors.

AMP255 calculates coefficient of variation upper bound as:

$$CV_{UB} = S * \sqrt{\frac{n-1}{\chi_{.1,n-1}}} \tag{23}$$

where n is the total number of single point QC checks, n-1 is degrees of freedom, S is the standard deviation of the n relative percent difference values (equation 19), and $\chi_{.1,n-1}$ is the 0.1 quantile of a chi-squared distribution (that is, the "lower critical value" of a one-tailed distribution at probability=1-α=0.9) with n-1 degrees of freedom. The value of $\chi_{.1,n-1}$ is obtained from AQS function *chi_squared_inv_prob*, which calculates the distribution value for a specified probability and degrees of freedom. The n in these equations is the total number of QC checks submitted, rather than the number of dates of QC checks (section 4.2.2) used for calculating completeness.

Values of CV are always positive. They have no leading sign and two decimal places.

4.5 Gaseous Pollutants PE Accuracy

The AMP255 output tables that summarize statistical estimates of accuracy of PE checks for gaseous pollutants (CO, NO2, O3, SO2) include the fields (report columns) listed in the following table. AMP255 generates two separate tables for each pollutant: a table for monitors in the PAMS-NAMS-SLAMS monitor type group ("NSP"), and a table for monitors in the "other" monitor type group ("Non-NSP"). Both tables have the same format.

The table titles are
- *Reporting Agency Accuracy Estimates for* [pollutant] *NSP Sites,* [date range]
- *Reporting Agency Accuracy Estimates for* [pollutant] *Non-NSP Sites,* [date range]

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
I (probability limits of level 1 audits)	n/a	Calculated. See section 4.5.2.	Value is null (empty) if limits cannot be calculated.
II (probability limits of level 2 audits)	n/a	Calculated. See section 4.5.2.	Value is null (empty) if limits cannot be calculated.
III (probability limits of level 3 audits)	n/a	Calculated. See section 4.5.2.	Value is null (empty) if limits cannot be calculated.
IV (probability limits of level 4 audits)	n/a	Calculated. See section 4.5.2.	Value is null (empty) if limits cannot be calculated.

4.5.1 Relative Percent Difference

Statistical estimates of CFR probability limits of accuracy audits are based on the *relative percent difference* values calculated from PE checks. Relative percent difference expresses the difference between the pollutant concentration indicated by monitoring equipment and the known concentration of the sample used in the check.

AQS software calculates relative percent difference for each PE check from the indicated and actual value pairs in table QA_DETAILS. Relative percent difference is calculated as:

$$d = 100 * \frac{(ind - act)}{act} \tag{24}$$

where *d* is relative percent difference, *ind* is the indicated value, and *act* is the actual value.

NOTE: The following range check is **not** performed by AMP255, but it may be added in a future version.

AMP255 omits a relative percent difference value if neither the indicated nor the actual value from which it was calculated is within the concentration range specified by the CFR. Table 2 lists the allowed concentration range of PE checks for each gaseous pollutant and audit level. To perform a range check, AMP255 obtains range limits for the pollutant and level from AQS table AUDIT_LEVELS, and rounds the indicated and actual values to the same number of decimal places as the range limits. A rounded value fails the range check if it is less than the lower limit or greater than the upper limit.

Table 2. CFR Concentration Ranges for PE Checks of Gaseous Pollutants

Pollutant	Allowed Concentration Range for Accuracy Audits (PPM)			
	Level 1	Level 2	Level 3	Level 4
CO	3-8	15-20	35-45	80-90
NO_2	0.03-0.08	0.15-0.20	0.35-0.45	NA
O_3	0.03-0.08	0.15-0.20	0.35-0.45	0.80-0.90
SO_2	0.03-0.08	0.15-0.20	0.35-0.45	0.80-0.90

4.5.2 Audit Level Lower and Upper 95% Probability Limits

Four table columns, *I, II, III,* and *IV*, give the 95% probability limits of relative percent difference values in each audit level (1, 2, 3, 4) for the time period of an AMP255 report. That is, table values in the *I* column are probability limits for PE checks in the level 1 concentration range, table values in the *II* column are probability limits for PE checks in the level 2 concentration range, and so on.

A table value consists of both lower and upper limits, separated by a comma and enclosed in parentheses. Lower and upper limit values have a leading sign (+ or -) and one decimal place.

A table value is null (empty) if AMP255 cannot calculate probability limits for the audit level because not enough valid PE checks were performed. At least 2 valid PE checks are required to calculate probability limits.

Probability limits are calculated from the pooled results of PE checks for all monitors in a monitor type group and reporting agency. Probability limits are not calculated for individual monitors.

AMP255 calculates the upper and lower 95% probability limits as:

$$Audit\ Level_j\ Upper\ Probability\ Limit = D_j + \left(1.96 * S_j\right)$$
$$Audit\ Level_j\ Lower\ Probability\ Limit = D_j - \left(1.96 * S_j\right)$$

(25)

where D_j and S_j are the mean and standard deviation of relative percent difference for a monitor type group, calculated from the group's n_j PE checks in audit level *j* as:

$$D_j = \frac{1}{n_j} \sum_{i=1}^{n_j} d_{j_i}$$

(26)

$$S_j = \sqrt{\frac{\left(n_j * \sum_{i=1}^{n_j} d_{j_i}{}^2\right) - \left(\sum_{i=1}^{n_j} d_{j_i}\right)^2}{n_j * (n_j - 1)}}$$

(27)

4.6 PM2.5 Collocation QC Completeness and Precision

The AMP255 output table summarizing completeness and precision of QC checks for collocated PM2.5 monitors includes the fields (report columns) listed in the following table.

The table title is *PM2.5 Collocation Summaries,* [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per primary monitor per 6 days	See section 4.6.1.
Number Submitted	PRECISION_DATA, QA_DETAILS	Calculated: Count of PRECISION_DATA dates	See section 4.6.2. Count of distinct dates of QC collocation checks in the report date range.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
% Sites <50%	n/a	Calculated as percent: (number sites ≤50% complete) / (number of collocated sites)	See section 4.6.3. Value is "NA" for site summaries.
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	See section 4.6.4. Value is "NA" for site summaries.
# of Sites Collocated	PRECISION_DATA, MONITOR_COLLOCATIONS	Calculated: count(distinct monitors)	See section 4.6.5. Value is "NA" for site summaries.
Site Completeness	n/a	Calculated based on requirement that 15% of sites are collocated.	See section 4.6.6. Value is "NA" for site summaries.

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Pairs >6	PRECISION_DATA, QA_DETAILS	Count of PRECISION_DATA rows	See section 4.6.7.
CV UB (upper bound)	n/a	Calculated.	See section 4.6.8.3.
CV Est.	n/a	Calculated.	See section 4.6.8.2.

4.6.1 Number of Collocation QC Checks Required (PM2.5)

One collocation QC check is required every six days for the primary monitor at a site. AMP255 calculates the number of checks required based on primary monitor start-end dates. Only primary monitors are listed in the report.

4.6.1.1   For a Site

The number of collocation QC checks required per site is the number of complete 6-day intervals during which the primary monitor at the site was in operation.

$$Number\ Required\ QC_{Site} = \text{floor}\left(\frac{(End\ Date - Start\ Date + 1)}{6}\right) \tag{28}$$

AMP255 omits a monitor from the report if the number of collocation QC checks required is less than one.

4.6.1.2   For a Monitor Type Group

The number of collocation QC checks required per monitor type group during the time period of the report is the sum of the number required by the monitors that comprise the group.

$$Number\ Required\ QC_{Group} = \sum_{i=1}^{n}\left(Number\ Required\ QC_{Site}\right)_i \tag{29}$$

where n is the number of primary monitors in a monitor type group.

4.6.2 Number of Collocation QC Checks Submitted (PM2.5)

This value is the number of dates on which collocation QC checks were performed, during the time period of the report, by the primary monitor of a site or all primary monitors of a monitor type group. The number of collocation checks excludes FRM checks, which are stored in the same AQS table (QA_DETAILS) as collocation checks. A FRM collocation check includes an agency code (SA_AG_AGENCY_CODE) while a regular collocation QC check does not.

4.6.2.1   For a Site

The number of collocation QC checks performed (submitted) per primary PM2.5 monitor is the number of distinct dates (PRECISION_DATA.PREC_DATE) on which collocation QC checks were performed for the monitor during the time period of the report.

$$Number\ Submitted\ QC_{Site} = \text{count}\left(\text{distinct}\ Date\ Check\ Performed\right) \tag{30}$$

If multiple collocation QC checks were submitted for the same date, AMP255 uses all of them to calculate statistical estimates of precision for the monitor (see section 4.6.8). For completeness, however, multiple QC checks on one date count as one check submitted.

AMP255 retrieves collocation QC checks from table PRECISION_DATA using these criteria:

- MP_MO_MO_ID refers to the primary monitor
- AUC_AUDIT_CLASS = 'COLLOCATED'
- PREC_DATE between *Start Date* and *End Date*
- SA_AG_AGENCY_CODE (in table QA_DETAILS) is null

The primary monitor of a site is identified by selecting rows of table MONITOR_COLLOCATIONS with this condition:

- PRI_MONITOR_IND = 'Y'

4.6.2.2   For a Monitor Type Group

The number of collocation QC checks submitted per monitor type group during the time period of the report is the sum of the number submitted by the monitors that comprise the group.

$$Number\ Submitted\ QC_{Group} = \sum_{i=1}^{n}\left(Number\ Submitted\ QC_{Site}\right)_i \qquad (31)$$

where n is the number of primary monitors in a monitor type group.

4.6.3 Percent of Sites Submitting Half or Less of Required Collocation QC Checks (PM2.5)

The percentage of sites that submitted half or less of required collocation QC checks during the time period of the report is calculated for monitor type groups, but not for monitors. (The value is "NA" for sites.)

$$Percent\ Sites \le 50\% = 100 * \frac{\text{count}\left(Percent\ Complete_{Site} \le 50\%\right)}{Number\ of\ collocated\ sites_{Group}} \qquad (32)$$

The number of collocated sites is defined below in section 4.6.5.

4.6.4 Total Number of Sites (PM2.5)

This value is a count of PM2.5 monitors that were active (had a sample period) during any part of the time period of the report, excluding collocated (duplicate) monitors. In other words, the count includes primary monitors of collocated pairs, and monitors that were not collocated. The value is calculated only for monitor type groups. (The value is "NA" for sites.)

For a monitor type group, the value is a count of the group's PM2.5 monitors selected for the report. AMP255 excludes (and therefore does not count) monitors designated as the duplicate monitor of a collocated pair. Duplicate monitors are identified by selecting rows of table MONITOR_COLLOCATIONS in which column PRI_MONITOR_IND = 'N'.

4.6.5 Number of Collocated Sites (PM2.5)

This value is a count of primary collocated PM2.5 monitors that were active (had a sample period) during any part of the time period of the report. The value is calculated only for monitor type groups. (The value is "NA" for sites.)

Collocated PM2.5 monitors are identified by the MONITOR_COLLOCATIONS table, which gives the time period during which a "primary" monitor was collocated with a "duplicate" monitor (or with multiple duplicate monitors). The primary monitor of a collocated pair must be listed in the MONITOR_COLLOCATIONS table, but the duplicate monitor does not have to be. The duplicate monitor might be used only for collocation QC checks rather than submitting normal sampling data.

Since duplicate monitors are not necessarily identified, AMP255 considers only primary collocated monitors. In table MONITOR_COLLOCATIONS, the primary monitor of a collocated pair has the value "Y" in column PRI_MONITOR_IND. A primary monitor's period of collocation is given by columns CLOC_BEGIN_DATE and CLOC_END_DATE. If CLOC_END_DATE is null, the collocation period has not yet ended.

For a monitor type group, the number of collocated sites is the number of PM2.5 monitors that:

- were a primary collocated monitor during any part of the time period of the report
- were active (had a sampling period) during the period of collocation

- had a monitor type in the monitor type group during the active period

4.6.6 Collocated Site Completeness (PM2.5)

At least 15% of a reporting agency's PM2.5 monitors must be collocated. If an agency has 3 or fewer PM2.5 monitors, one pair of them must be collocated. The *Site Completeness* column is the percentage of an agency's total number of PM2.5 monitors (section 4.6.4) that were primary collocated monitors during some part of the time period of the report. The *Site Completeness* value has no decimal places and is capped at 100%.

For a monitor type group, AMP255 calculates collocated site completeness as:

$$Collocated\ Sites\ Required = \max\big(1, round(0.15 * Total\ Number\ of\ Sites, 1)\big) \qquad (33)$$

$$Site\ Completeness = round\left(100 * \min\left(1, \frac{Number\ of\ Collocated\ Sites}{Collocated\ Sites\ Required}\right), 1\right) \qquad (34)$$

Total Number of Sites and *Number of Collocated Sites* are defined in sections 4.6.4 and 4.6.5 above.

4.6.7 Number of Pairs >6 (PM2.5)

The CFR stipulates that precision estimates of collocated PM2.5 monitors be based on samples having a PM2.5 concentration greater than 6 micrograms per cubic meter. The *Number of Pairs >6* column is the count of collocation QC checks that meet that requirement. It is the *n* value for CV calculations described in the following two sections.

AMP255 determines if a collocation check's value pair meets the minimum concentration requirement using function PA_SUMMARY.ARE_PREC_VALUES_VAL, which compares the value pair with the concentration threshold obtained from table PARAMETERS (column MIN_COLLOCATED_VALUE).

AMP255 determines the count of valid QC collocation checks, for each primary monitor and monitor type group, by counting rows of table PRECISION_DATA associated with value pairs that meet the PM2.5 minimum concentration requirement. Since this value is a count of QC checks rather than the dates of QC checks, *Number of Pairs >6* could be greater than *Number Submitted* (section 4.6.2) if multiple collocation checks were submitted on the same date.

4.6.8 Precision Estimates for Collocation QC Checks (PM2.5)

Columns *CV UB* (coefficient of variation upper bound) and *CV Est.* (coefficient of variation estimate) are estimates of the precision of PM2.5 collocation QC checks. Both values are calculated from the relative percent difference between the PM2.5 concentrations measured by the two monitors of a collocated pair.

4.6.8.1 Relative Percent Difference
For each valid PM2.5 collocation QC check, AMP255 calculates relative percent difference as:

$$d_i = 100 * \frac{duplicate_i - primary_i}{(duplicate_i + primary_i)/2} \qquad (35)$$

where d_i is relative percent difference for the *i*-th collocation QC check, and $primary_i$ and $duplicate_i$ are the PM2.5 concentrations recorded in by the primary (routine) and duplicate (collocated) monitors of the collocated pair.

AMP255 omits a relative percent difference value if both $primary_i$ and $duplicate_i$ values, after rounding to integers, are not greater than 6 micrograms per cubic meter. The number of valid relative percent difference values is *Number of Pairs >6* (section 4.6.7).

4.6.8.2 Coefficient of Variation Estimate
Column *CV Est.* is the coefficient of variation of the valid relative percent difference values of collocation QC checks for the time period of an AMP255 report. Coefficient of variation is calculated for each primary

monitor and each monitor type group. That is, a coefficient of variation estimate is calculated for each monitor's QC checks, for the pooled QC checks of a reporting agency's PAMS-NAMS-SLAMS monitors, and for the pooled QC checks of the agency's "other" monitors. *CV Est.* values have no leading sign and two decimal places.

AMP255 calculates coefficient of variation as:

$$CV = \sqrt{\frac{\sum_{i=1}^{n} \left(\frac{|d_i|}{\sqrt{2}} \right)^2}{n}} = \sqrt{\frac{\sum_{i=1}^{n} d_i^2}{2*n}} \tag{36}$$

where d_i is a valid relative percent difference value (section 4.6.8.1) and n is number of them (*Number of Pairs >6*, section 4.6.7). The factor of 2 in the denominator of the equation adjusts for the fact that each d_i is calculated from two values with error.

4.6.8.3   Coefficient of Variation Upper Bound

Column *CV UB* is the 90% confidence upper limit of the coefficient of variation estimate (section 4.6.8.2). An estimate of coefficient of variation upper bound is calculated for each primary monitor and each monitor type group. That is, a coefficient of variation upper bound estimate is calculated for each monitor's QC checks, for the pooled QC checks of a reporting agency's PAMS-NAMS-SLAMS monitors, and for the pooled QC checks of the agency's "other" monitors. *CV UB* values have no leading sign and two decimal places.

AMP255 calculates coefficient of variation upper bound as:

$$CV_{UB} = \sqrt{\frac{\left(n * \sum_{i=1}^{n} d_i^2 \right) - \left(\sum_{i=1}^{n} d_i \right)^2}{2*n*(n-1)}} * \sqrt{\frac{n-1}{\chi_{.1,n-1}}} \tag{37}$$

where CV_{UB} is coefficient of variation upper bound, d_i is a valid relative percent difference value (section 4.6.8.1), n is the number of valid relative percent difference values (*Number of Pairs >6*, section 4.6.7), and $\chi_{.1,n-1}$ is the 0.1 quantile of a chi-squared distribution (that is, the "lower critical value" of a one-tailed distribution at probability=1-α=0.9) with n-1 degrees of freedom. The value of $\chi_{.1,n-1}$ is obtained from AQS function *chi_squared_inv_prob*, which calculates the distribution value for a specified probability and degrees of freedom.

4.7 Manual PM2.5 Flow Rate Audit Completeness

The AMP255 output table summarizing completeness of quarterly flow rate PE checks of PM2.5 monitors with manual samplers includes the fields (report columns) listed in the following table.

The table title is *Manual PM2.5 Flow Rate Completeness,* [date range].

Report Label	Database Mapping Table or View	Column	Notes
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per monitor per quarter	See section 4.7.1. Count of PE flow checks required.
Number Submitted	ACCURACY_DATA	Calculated: count ACCURACY_DATA dates	See section 4.7.2. Count of PE flow checks performed.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	Value is "NA" for site summaries.
Audits in Quarters 1/2/3/4	ACCURACY_DATA	Calculated: count ACCURACY_DATA dates	See section 4.7.3. Four quarterly counts are listed, in this format: Q1/Q2/Q3/Q4. Value is "NA" for sites.

4.7.1 Number of Flow Rate Audits Required (Manual PM2.5)

One flow rate PE check per calendar quarter is required for each PM2.5 primary monitor and non-collocated monitor. Flow rate checks are not required for collocated (duplicate) monitors, which are omitted from the report. AMP255 calculates the number of flow rate checks required based on monitor start-end dates.

4.7.1.1 For a Site

The number of flow rate PE checks required per monitor is the number of complete calendar quarters during which a manual PM2.5 monitor was active. To compute the number of complete quarters, AMP255 first adjusts *Start Date* (section 4.1.2) forward to the first date of the next quarter, and adjusts *End Date* (section 4.1.4) backward to the first date of the quarter. (If *Start Date* or *End Date* is the first date of a quarter, it is not adjusted.)

$$adjusted\ StartDate = \text{decode}\begin{pmatrix} StartDate - \text{trunc}(StartDate, 'q'), \\ 0, StartDate, \\ \text{trunc}(\text{trunc}(StartDate, 'q') + 92, 'q') \end{pmatrix} \tag{38}$$

$$adjusted\ EndDate = \text{trunc}(EndDate + 89, 'q') \tag{39}$$

AMP255 then computes the number of flow rate PE checks required (*i.e.*, the number of quarters) for the monitor as:

$$Number\ Audits\ Required_{Site} = \frac{\text{months\_between}\begin{pmatrix} adjusted & adjusted \\ EndDate' & StartDate \end{pmatrix}}{3} \tag{40}$$

AMP255 omits a monitor from the report if the number of flow rate checks required is less than one.

4.7.1.2 For a Monitor Type Group

The number of flow rate PE checks required per monitor type group during the time period of the report is the sum of the number required by the monitors that comprise the group.

$$Number\ Audits\ Required_{Group} = \sum_{i=1}^{n} \left(Number\ Audits\ Required_{Site} \right)_i \tag{41}$$

where n is the number of monitors in a monitor type group.

4.7.2 Number of Flow Rate Audits Submitted (Manual PM2.5)

4.7.2.1 For a Site

The number of flow rate PE checks performed by a manual PM2.5 monitor is the number of distinct dates (ACCURACY_DATA.ACC_DATE) on which "flow" PE checks were performed for that monitor, for quarters in the time period of the report. The pertinent rows of table ACCURACY_DATA are selected with these conditions:

- ACC_DATE within the range *Start Date* through *End Date*
- AUDIT_CLASS = 'FLOW'
- ACT_ACC_TYPE = 'PE'

4.7.2.2 For a Monitor Type Group

The number of flow rate PE checks submitted for a monitor type group is the sum of monitor counts for the corresponding monitor type group and reporting agency.

4.7.3 Number of Audits by Quarter (Manual PM2.5)

The column labeled *Audits in Quarters 1/2/3/4* lists the number of flow rate PE checks submitted in each calendar quarter for a monitor type group. (For a site, the value is "NA".) The four quarterly counts are separated by slashes:

$$AuditCount_{Q1}/AuditCount_{Q2}/AuditCount_{Q3}/AuditCount_{Q4}$$

The number of "audits" in a quarter is the total number of distinct dates on which flow rate PE checks were performed by monitors comprising the monitor type group. For example, the number of PE checks in the first quarter is the number of distinct dates (ACC_DATE) in ACCURACY_DATA rows having

QTR_REPRESENTED=1. The sum of the four quarterly counts is the total number of PE checks submitted for the monitor type group.

Audits in Quarters 1/2/3/4 consists of four counts, regardless of the time period of the report. If the time period is less than one year, counts for the excluded quarters are zero. If the report time period is more than one year, the counts for some quarters include audits submitted in multiple years. For example, if the report time period were 2003-Q1 through 2004-Q2, the audit counts for quarters 1 and 2 would be totals of 2003 and 2004 audits, while the audit counts for quarters 3 and 4 would represent 2003 audits only.

4.8 Automated PM10 Flow Rate QC Completeness

The AMP255 output table summarizing completeness of flow rate QC checks for PM10 monitors with automated samplers includes the fields (report columns) listed in the following table.

The table title is *Automated PM10 Precision Completeness,* [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per monitor per 14 days	See section 4.8.1.
Number Submitted	PRECISION_DATA	Calculated: count PRECISION_DATA dates	See section 4.8.2. Count of distinct dates of flow rate QC checks in the report date range
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
% Sites <50% Complete	n/a	Calculated as percent: (number sites ≤50% complete) / (number of collocated sites)	See section 4.8.3. Value is "NA" for site summaries.

4.8.1 Number of Flow Rate QC Checks Required (Automated PM10)

One flow rate QC check is required every 14 days for each automated PM10 monitor that is the primary of a collocated pair or is not collocated. AMP255 calculates the number of checks required based on monitor start-end dates.

4.8.1.1   For a Site
The number of flow rate QC checks required per monitor is the number of complete 14-day intervals during which the monitor was active.

$$Number\ Required\ QC_{Site} = \text{floor}\left(\frac{(End\ Date - Start\ Date + 1)}{14}\right) \qquad (42)$$

AMP255 omits a monitor from the report if the number of flow rate QC checks required is less than one.

4.8.1.2   For a Monitor Type Group

The number of flow rate QC checks required per monitor type group during the time period of the report is the sum of the number required by the monitors that comprise the group.

$$Number\ Required\ QC_{Group} = \sum_{i=1}^{n}\left(Number\ Required\ QC_{Site}\right)_i \qquad (43)$$

where n is the number of monitors in a monitor type group.

4.8.2 Number of Flow Rate QC Checks Submitted (Automated PM10)

4.8.2.1   For a Site

The number of flow rate QC checks performed for an automated PM10 monitor is the number of distinct dates (PRECISION_DATA.PREC_DATE) on which flow rate QC checks were performed for the monitor during the time period of the report. AMP255 selects the pertinent rows of table PRECISION_DATA (and related tables) using these criteria:

- recording mode = 'CONTINUOUS'
- audit class = 'FLOW'
- QC check date between *Begin Date* and *End Date*

4.8.2.2   For a Monitor Type Group

The number of PM10 flow rate QC checks submitted for a monitor type group is the sum of monitor counts for the corresponding monitor type group and reporting agency.

4.8.3 Percent of Sites Submitting Half or Less of Required Flow Rate QC Checks (Automated PM10)

The percentage of monitors that submitted half or less of required flow rate QC checks during the time period of the report is calculated for monitor type groups only. (The value is "NA" for monitors.)

$$Percent\ Sites \leq 50\% = 100 * \frac{\text{count}\left(Percent\ Complete_{Site} \leq 50\%\right)}{\text{count}\left(Monitors\ in\ group\right)} \qquad (44)$$

4.9 PM10 Flow Rate Audit Completeness

The AMP255 output tables that summarize completeness of flow rate PE checks for PM10 monitors include the fields (report columns) listed in the following table. AMP255 generates two separate tables, for PM10 monitors that use automated samplers and PM10 monitors that use manual samplers.

The table titles are:
- *Automated PM10 Accuracy Completeness,* [date range]
- *Manual PM10 Accuracy Completeness,* [date range]

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_PERIODS	SAMPLING_BEGIN_DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_PERIODS	SAMPLING_END_DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per site per year	See section 4.9.1.
Number Submitted	ACCURACY_DATA	Calculated: count of ACCURACY_DATA dates	See section 4.9.2.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	Value is "NA" for site summaries.
Audits in Quarters 1/2/3/4	ACCURACY_DATA	Calculated: count of ACCURACY_DATA dates	See section 4.9.3. Four quarterly counts are listed, in this format: Q1/Q2/Q3/Q4. Value is "NA" for monitors.

4.9.1 Number of Flow Rate Audits Required (PM10)

Each PM10 monitor that uses an automated or manual sampler must have at least one flow rate PE check per year, and each reporting agency must conduct at least one flow rate PE check per quarter for each

monitor type group. If an agency has fewer than four monitors in a monitor type group, it must conduct multiple flow rate checks of monitors in the group in order to satisfy the one-audit-per-quarter requirement. Flow rate PE checks are not required for collocated (duplicate) PM10 monitors, which are omitted from the report.

4.9.1.1   For a Site
One flow rate PE check is required per monitor per year. If the report date range includes a partial year, AMP255 rounds up to a whole year.

$$\begin{array}{l} \textit{Number Required} \\ \textit{Flow Rate Audits}_{Site} \end{array} = \text{ceil}\left(\frac{\text{count}\left(\textit{quarters in report date range}\right)}{4} \right) \qquad (45)$$

4.9.1.2   For a Monitor Type Group
The larger of one flow rate PE check per monitor per year or one per calendar quarter is required per monitor type group per agency.

$$\begin{array}{l} \textit{Number Required} \\ \textit{Flow Rate Audits}_{Group} \end{array} = \max\left(\begin{array}{l} \text{count}\left(\textit{quarters in report date range}\right), \\ \displaystyle\sum_{Sites} \textit{Number Required Flow Rate Audits}_{Site} \end{array} \right) \qquad (46)$$

4.9.2 Number of Flow Rate Audits Submitted (PM10)

4.9.2.1   For a Site
The number of flow rate PE checks performed by a PM10 monitor is the number of distinct dates (ACCURACY_DATA.ACC_DATE) on which flow rate PE checks were performed for that monitor during the time period of the report. The pertinent rows of table ACCURACY_DATA are selected with these conditions:

- ACC_DATE within the range *Start Date* through *End Date*
- AUDIT_CLASS = 'FLOW'
- ACT_ACC_TYPE = 'PE'

4.9.2.2   For a Monitor Type Group
The number of PM10 flow rate PE checks submitted for a monitor type group is the sum of monitor counts for the corresponding sampler type (automated or manual), monitor type group, and reporting agency.

4.9.3 Number of Audits by Quarter (PM10)

The column labeled *Audits in Quarters 1/2/3/4* lists the number of flow rate PE checks submitted in each calendar quarter for a monitor type group. (For a site, the value is "NA".) The four quarterly counts are separated by slashes:

$$\text{AuditCount}_{Q1}/\text{AuditCount}_{Q2}/\text{AuditCount}_{Q3}/\text{AuditCount}_{Q4}$$

The number of "audits" in a quarter is the number of distinct dates on which flow rate PE checks were performed by monitors comprising the monitor type group. For example, the number of PE checks in the first quarter is the number of distinct dates (ACC_DATE) in ACCURACY_DATA rows having QTR_REPRESENTED=1. The sum of the four quarterly counts is the total number of PE checks submitted for the monitor type group (section 4.9.2.2).

Audits in Quarters 1/2/3/4 consists of four counts, regardless of the time period of the report. If the time period is less than one year, counts for the excluded quarters are zero. If the report time period is more than one year, the counts for some quarters include audits submitted in multiple years. For example, if the report time period were 2003-Q1 through 2004-Q2, the audit counts for quarters 1 and 2 would be totals of 2003 and 2004 audits, while the audit counts for quarters 3 and 4 would represent 2003 audits only.

4.10 Manual PM10 Collocation QC Completeness and Precision

The AMP255 output table summarizing completeness and precision of QC checks for collocated PM10 monitors with manual samplers includes the fields (report columns) listed in the following table.

The table title is *Manual PM10 Precision,* [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per site per 6 days	See section 4.10.1.
Number Submitted	PRECISION_DATA, QA_DETAILS	Count of PRECISION_DATA dates	See section 4.10.2. Count of distinct dates of QC collocation checks in the report date range.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
% Sites <50% Complete	n/a	Calculated as percent: (number sites ≤50% complete) / (number of collocated sites)	See section 4.10.3. Value is "NA" for site summaries.
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	See section 4.10.4. Value is "NA" for site summaries.
# of Sites Collocated	PRECISION_DATA, MONITOR_COLLOCATIONS	Calculated: count(distinct monitors)	See section 4.10.5. Value is "NA" for site summaries.
Site Completeness	n/a	Calculated based on required number of collocated sites.	See section 4.10.6. Value is "NA" for site summaries.

Report Label	Database Mapping		Notes
	Table or View	Column	
Pairs >20	PRECISION_DATA, QA_DETAILS	Count of PRECISION_DATA rows	See section 4.10.7.
CV UB (upper bound)	n/a	Calculated.	See section 4.10.8.2.
Lower 95% Prob. Limit	n/a	Calculated.	See section 4.10.8.3.
Upper 95% Prob. Limit	n/a	Calculated.	See section 4.10.8.3.

4.10.1   Number of Collocation QC Checks Required (Manual PM10)

One collocation QC check is required every six days for the primary monitor at a site. AMP255 calculates the number of checks required based on primary monitor start-end dates. Only primary monitors are listed in the report.

4.10.1.1   For a Site

The number of collocation QC checks required per site is the number of complete 6-day intervals during which the primary PM10 monitor at the site was in operation.

$$Number\ Required\ QC_{Site} = \text{floor}\left(\frac{(End\ Date - Start\ Date + 1)}{6}\right) \tag{47}$$

AMP255 omits a monitor from the report if the number of collocation QC checks required is less than one.

4.10.1.2   For a Monitor Type Group

The number of collocation QC checks required per monitor type group during the time period of the report is the sum of the number required by the monitors that comprise the group.

$$Number\ Required\ QC_{Group} = \sum_{i=1}^{n} \left(Number\ Required\ QC_{Site}\right)_i \tag{48}$$

where n is the number of primary monitors in a monitor type group.

4.10.2   Number of Collocation QC Checks Submitted (Manual PM10)

This value is the number of dates on which collocation QC checks were performed, during the time period of the report, by the primary monitor of a site or all primary monitors of a monitor type group. The number of collocation checks excludes FRM checks, which are stored in the same AQS table (QA_DETAILS) as collocation checks. A FRM collocation check includes an agency code (SA_AG_AGENCY_CODE) while a regular collocation QC check does not.

4.10.2.1   For a Site

The number of collocation QC checks performed (submitted) per primary PM10 monitor is the number of distinct dates (PRECISION_DATA.PREC_DATE) on which collocation QC checks were performed for the monitor during the time period of the report.

$$Number\ Submitted\ QC_{Site} = \text{count}\left(\text{distinct } Date\ Check\ Performed\right) \tag{49}$$

If multiple collocation QC checks were submitted for the same date, AMP255 uses all of them to calculate statistical estimates of precision for the monitor (see section 4.10.8). For completeness, however, multiple QC checks on one date count as one check submitted.

AMP255 retrieves collocation QC checks from table PRECISION_DATA using these criteria:

- MP_MO_MO_ID refers to the primary monitor
- AUC_AUDIT_CLASS = 'COLLOCATED'
- PREC_DATE between *Start Date* and *End Date*
- SA_AG_AGENCY_CODE (in table QA_DETAILS) is null

The primary monitor of a site is identified by selecting rows of table MONITOR_COLLOCATIONS with this condition:

- PRI_MONITOR_IND = 'Y'

4.10.2.2 For a Monitor Type Group
The number of collocation QC checks submitted per monitor type group during the time period of the report is the sum of the number submitted by the monitors that comprise the group.

$$Number\ Submitted\ QC_{Group} = \sum_{i=1}^{n} \left(Number\ Submitted\ QC_{Site} \right)_i \qquad (50)$$

where n is the number of primary monitors in a monitor type group.

4.10.3 Percent of Sites Submitting Half or Less of Required Collocation QC Checks (Manual PM10)

The percentage of sites that submitted half or less of required collocation QC checks during the time period of the report is calculated for monitor type groups, but not for sites. (The value is "NA" for sites.)

$$Percent\ Sites \leq 50\% = 100 * \frac{\text{count}\left(Percent\ Complete_{Site} \leq 50\% \right)}{Number\ of\ collocated\ sites_{Group}} \qquad (51)$$

The count of collocated sites is defined below in section 4.10.5.

4.10.4 Total Number of Sites (Manual PM10)

This value is a count of manual PM10 monitors that were active (had a sample period) during any part of the time period of the report, excluding collocated (duplicate) monitors. In other words, the count includes primary monitors of collocated pairs, and monitors that were not collocated. The value is calculated only for monitor type groups. (The value is "NA" for sites.)

For a monitor type group, the value is a count of the group's manual PM10 monitors selected for the report. AMP255 excludes (and therefore does not count) monitors designated as the duplicate monitor of a collocated pair. Duplicate monitors are identified by selecting rows of table MONITOR_COLLOCATIONS in which column PRI_MONITOR_IND = 'N'.

4.10.5 Number of Collocated Sites (Manual PM10)

This value is a count of primary collocated PM10 monitors with manual sampling methods that were active (had a sample period) during any part of the time period of the report. The value is calculated for monitor type groups, but not for sites. (The value is "NA" for sites.)

Collocated PM10 monitors are identified by the MONITOR_COLLOCATIONS table, which gives the time period during which a "primary" monitor was collocated with a "duplicate" monitor (or with multiple duplicate monitors). The primary monitor of a collocated pair must be listed in the MONITOR_COLLOCATIONS table, but the duplicate monitor does not have to be. The duplicate monitor might be used only for collocation QC checks rather than submitting normal sampling data.

Since duplicate monitors are not necessarily identified, AMP255 considers only primary collocated monitors. In table MONITOR_COLLOCATIONS, the primary monitor of a collocated pair has the value "Y" in column PRI_MONITOR_IND. A primary monitor's period of collocation is given by columns CLOC_BEGIN_DATE and CLOC_END_DATE. If CLOC_END_DATE is null, the collocation period has not yet ended.

For a monitor type group, the number of collocated sites is the number of PM10 monitors that:

- were a primary collocated monitor during any part of the time period of the report
- were active (had a sampling period) during the period of collocation
- used a manual sampling protocol during the active period
- had a monitor type in the monitor type group during the active period

4.10.6   Collocated Site Completeness (Manual PM10)

The number of collocated PM10 monitors required for a reporting agency depends on the total number of PM10 monitors operated by the agency.

Total Number of PM10 Sites (section 4.10.4)	Required Number of Collocated PM10 Sites
1 - 5	1
6 - 20	2
>20	3

As discussed in section 4.10.4 above, the total number of PM10 monitors excludes collocated (duplicate) monitors. AMP255 also excludes PM10 monitors that use automated (continuous) sampling protocols. Therefore, site completeness considers only manual PM10 monitors.

The *Site Completeness* column is the percentage of an agency's total number of PM10 monitors (section 4.10.4) that were primary collocated monitors during some part of the time period of the report. The *Site Completeness* value has no decimal places and is capped at 100%.

For a monitor type group, AMP255 calculates collocated site completeness as:

$$Collocated\ Sites\ Required = \begin{cases} 1, & 1\text{-}5\ \text{total sites} \\ 2, & 6\text{-}20\ \text{total sites} \\ 3, & >20\ \text{total sites} \end{cases} \tag{52}$$

$$Site\ Completeness = \text{round}\left(100 * \min\left(1, \frac{Number\ of\ Collocated\ Sites}{Collocated\ Sites\ Required}\right), 0\right) \tag{53}$$

Total Number of Sites and *Number of Collocated Sites* are defined in sections 4.10.4 and 4.10.5 above.

4.10.7   Number of Pairs >20 (Manual PM10)

The CFR stipulates that precision estimates of collocated PM10 monitors be based on samples having a PM10 concentration greater than 20 micrograms per cubic meter. The *Number of Pairs >20* column is the count of collocation QC checks that meet the requirement. It is the *n* value for CV calculations described in the following two sections.

AMP255 determines if a collocation check's value pair meets the minimum concentration requirement using function PA_SUMMARY.ARE_PREC_VALUES_VAL, which compares the value pair with the concentration threshold obtained from table PARAMETERS (column MIN_COLLOCATED_VALUE).

AMP255 determines the count of valid QC collocation checks, for each primary monitor and monitor type group, by counting rows of table PRECISION_DATA associated with value pairs that meet the PM10 minimum concentration requirement.

4.10.8   Precision Estimates for Collocation QC Checks (Manual PM10)

Columns *CV UB* (coefficient of variation upper bound) and *Lower/Upper 95% Prob. Limit.* (lower and upper bounds of 95% probability) are estimates of the precision of PM10 collocation QC checks. The

values are calculated from the relative percent difference between the PM10 concentrations measured by the two monitors of a collocated pair.

4.10.8.1   Relative Percent Difference

For each valid PM10 collocation QC check, AQS calculates relative percent difference as:

$$d_i = 100 * \frac{duplicate_i - primary_i}{(duplicate_i + primary_i)/2} \tag{54}$$

where d_i is relative percent difference for the *i*-th collocation QC check, and *primary*$_i$ and *duplicate*$_i$ are the PM10 concentrations recorded in by the primary (routine) and duplicate (collocated) monitors of the collocated pair.

AMP255 omits a relative percent difference value if both *primary*$_i$ and *duplicate*$_i$ values, after rounding to integers, are not greater than 20 micrograms per cubic meter. The number of valid relative percent difference values is *Number of Pairs >20* (section 4.10.7).

4.10.8.2   Coefficient of Variation Upper Bound

Column *CV UB* is the 90% confidence upper limit of coefficient of variation of valid relative percent difference values for manual PM10 collocation QC checks. An estimate of coefficient of variation upper bound is calculated for each primary monitor and each monitor type group. That is, a coefficient of variation upper bound estimate is calculated for each monitor's QC checks, for the pooled QC checks of a reporting agency's PAMS-NAMS-SLAMS monitors, and for the pooled QC checks of the agency's "other" monitors. *CV UB* values have no leading sign and one decimal place.

AMP255 calculates coefficient of variation upper bound as:

$$CV_{UB} = \sqrt{\frac{\left(n * \sum_{i=1}^{n} d_i^{\,2}\right) - \left(\sum_{i=1}^{n} d_i\right)^2}{2 * n * (n-1)}} * \sqrt{\frac{n-1}{\chi_{.1,n-1}}} \tag{55}$$

where CV_{UB} is coefficient of variation upper bound, d_i is a valid relative percent difference value (section 4.10.8.1), *n* is the number of valid relative percent difference values (*Number of Pairs >20*, section 4.10.7), and $\chi_{.1,n-1}$ is the 0.1 quantile of a chi-squared distribution (that is, the "lower critical value" of a one-tailed distribution at probability=1-α=0.9) with *n*-1 degrees of freedom. The value of $\chi_{.1,n-1}$ is obtained from AQS function *chi_squared_inv_prob*, which calculates the distribution value for a specified probability and degrees of freedom. The factor of 2 in the denominator of the CV_{UB} equation adjusts for the fact that each d_i is calculated from two values with error.

4.10.8.3   Lower and Upper 95% Probability Limits

Two table columns, *Lower 95% Prob. Limit* and *Upper 95% Prob. Limit*, give the 95% probability limits of relative percent difference values of manual PM10 collocation QC checks during the time period of an AMP255 report. The probability limits are calculated for each primary collocated PM10 monitor and each monitor type group. Probability limit values have a leading sign (+ or -) and one decimal place.

AMP255 calculates the upper and lower 95% probability limits as:

$$\begin{array}{l} Upper\ 95\%\ Probability\ Limit = D + (1.96 * S) \\ Lower\ 95\%\ Probability\ Limit = D - (1.96 * S) \end{array} \tag{56}$$

where *D* and *S* are the mean and standard deviation of relative percent difference for a site or monitor type group, calculated from *n* valid single point QC checks as:

$$D = \frac{1}{n} \sum_{i=1}^{n} d_i \tag{57}$$

$$S = \sqrt{\frac{\left(n * \sum_{i=1}^{n} d_i^2\right) - \left(\sum_{i=1}^{n} d_i\right)^2}{n * (n-1)}} \tag{58}$$

4.11 Lead (Pb) Collocation QC Completeness

The AMP255 output table summarizing completeness of QC checks for collocated Pb monitors includes the fields (report columns) listed in the following table.

The table title is *Pb Collocation Completeness,* [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per site per 6 days	See section 4.11.1.
Number Submitted	PRECISION_DATA, QA_DETAILS	Count of PRECISION_DATA dates	See section 4.11.2. Count of distinct dates of QC collocation checks in the report date range.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
% Sites <50% Complete	n/a	Calculated as percent: (number sites ≤50% complete) / (number of collocated sites)	See section 4.11.3. Value is "NA" for site summaries.
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	See section 4.11.4 Value is "NA" for site summaries.
# of Sites Collocated	PRECISION_DATA, MONITOR_COLLOCATIONS	Calculated: count(distinct monitors)	See section 4.11.5. Value is "NA" for site summaries.
Site Completeness	n/a	Calculated based on required number of collocated sites.	See section 4.11.6. Value is "NA" for site summaries.

4.11.1 Number of Collocation QC Checks Required (Pb)

One collocation QC check is required every six days for the primary monitor at a site. AMP255 calculates the number of checks required based on primary monitor start-end dates. Only primary monitors are listed in the report.

4.11.1.1 For a Site

The number of collocation QC checks required per site is the number of complete 6-day intervals during which the primary Pb monitor at the site was in operation.

$$Number\ Required\ QC_{Site} = floor\left(\frac{(End\ Date - Start\ Date + 1)}{6}\right) \tag{59}$$

AMP255 omits a monitor from the report if the number of collocation QC checks required is less than one.

4.11.1.2 For a Monitor Type Group

The number of collocation QC checks required per monitor type group during the time period of the report is the sum of the number required by the monitors that comprise the group.

$$Number\ Required\ QC_{Group} = \sum_{i=1}^{n} \left(Number\ Required\ QC_{Site}\right)_i \tag{60}$$

where n is the number of primary monitors in a monitor type group.

4.11.2 Number of Collocation QC Checks Submitted (Pb)

This value is the number of dates on which collocation QC checks were performed, during the time period of the report, by the primary monitor of a site or all primary monitors of a monitor type group. The number of collocation checks excludes FRM checks, which are stored in the same AQS table (QA_DETAILS) as collocation checks. A FRM collocation check includes an agency code (SA_AG_AGENCY_CODE) while a regular collocation QC check does not.

4.11.2.1 For a Site

The number of collocation QC checks performed (submitted) per primary Pb monitor is the number of distinct dates (PRECISION_DATA.PREC_DATE) on which collocation QC checks were performed for the monitor during the time period of the report.

$$Number\ Submitted\ QC_{Site} = count(distinct\ Date\ Check\ Performed) \tag{61}$$

AMP255 retrieves collocation QC checks from table PRECISION_DATA using these criteria:

- MP_MO_MO_ID refers to the primary monitor
- AUC_AUDIT_CLASS = 'COLLOCATED'
- PREC_DATE between *Start Date* and *End Date*
- SA_AG_AGENCY_CODE (in table QA_DETAILS) is null

The primary monitor of a site is identified by selecting rows of table MONITOR_COLLOCATIONS with this condition:

- PRI_MONITOR_IND = 'Y'

4.11.2.2 For a Monitor Type Group

The number of collocation QC checks submitted per monitor type group during the time period of the report is the sum of the number submitted by the monitors that comprise the group.

$$Number\ Submitted\ QC_{Group} = \sum_{i=1}^{n} \left(Number\ Submitted\ QC_{Site}\right)_i \tag{62}$$

where n is the number of primary monitors in a monitor type group.

4.11.3   Percent of Sites Submitting Half or Less of Required Collocation QC Checks (Pb)

The percentage of sites that submitted half or less of required collocation QC checks during the time period of the report is calculated for monitor type groups, but not for sites. (The value is "NA" for sites.)

$$Percent\ Sites \le 50\% = 100 * \frac{\text{count}(Percent\ Complete_{Site} \le 50\%)}{Number\ of\ collocated\ sites_{Group}} \qquad (63)$$

The number of collocated sites is defined below in section 4.11.5.

4.11.4   Total Number of Sites (Pb)

This value is a count of manual Pb monitors that were active (had a sample period) during any part of the time period of the report, excluding collocated (duplicate) monitors. In other words, the count includes primary monitors of collocated pairs, and monitors that were not collocated. The value is calculated only for monitor type groups. (The value is "NA" for sites.)

For a monitor type group, the value is a count of the group's Pb monitors selected for the report. AMP255 excludes (and therefore does not count) monitors designated as the duplicate monitor of a collocated pair. Duplicate monitors are identified by selecting rows of table MONITOR_COLLOCATIONS in which column PRI_MONITOR_IND = 'N'.

4.11.5   Number of Collocated Sites (Pb)

This value is a count of primary collocated Pb monitors that were active (had a sample period) during any part of the time period of the report. The value is calculated for monitor type groups, but not for sites. (The value is "NA" for sites.)

Collocated Pb monitors are identified by the MONITOR_COLLOCATIONS table, which gives the time period during which a "primary" monitor was collocated with a "duplicate" monitor (or with multiple duplicate monitors). The primary monitor of a collocated pair must be listed in the MONITOR_COLLOCATIONS table, but the duplicate monitor does not have to be. The duplicate monitor might be used only for collocation QC checks rather than submitting normal sampling data.

Since duplicate monitors are not necessarily identified, AMP255 considers only primary collocated monitors. In table MONITOR_COLLOCATIONS, the primary monitor of a collocated pair has the value "Y" in column PRI_MONITOR_IND. A primary monitor's period of collocation is given by columns CLOC_BEGIN_DATE and CLOC_END_DATE. If CLOC_END_DATE is null, the collocation period has not yet ended.

For a monitor type group, the number of collocated sites is the number of Pb monitors that:

- were a primary collocated monitor during any part of the time period of the report
- were active (had a sampling period) during the period of collocation
- had a monitor type in the monitor type group during the active period

4.11.6   Collocated Site Completeness (Pb)

The number of collocated Pb monitors required for a reporting agency depends on the total number of Pb monitors operated by the agency. As discussed in section 4.11.4 above, the total number of Pb monitors excludes collocated (duplicate) monitors.

Total Number of Pb Sites (section 4.11.4)	Required Number of Collocated Pb Sites
1 - 5	1
6 - 20	2
>20	3

The *Site Completeness* column is the percentage of an agency's total number of Pb monitors (section 4.11.4) that were primary collocated monitors during some part of the time period of the report. The *Site Completeness* value has no decimal places and is capped at 100%.

For a monitor type group, AMP255 calculates collocated site completeness as:

$$
Collocated\ Sites\ Required = \begin{cases} 1, & 1\text{-}5\ \text{total sites} \\ 2, & 6\text{-}20\ \text{total sites} \\ 3, & >20\ \text{total sites} \end{cases} \tag{64}
$$

$$
Site\ Completeness = \text{round}\left(100 * \min\left(1, \frac{Number\ of\ Collocated\ Sites}{Collocated\ Sites\ Required}\right), 1\right) \tag{65}
$$

Total Number of Sites and *Number of Collocated Sites* are defined in sections 4.11.5 and 4.11.5 above.

4.12 Lead (Pb) Flow Rate Audit Completeness

The AMP255 output table summarizing completeness of flow rate PE checks for Pb monitors includes the fields (report columns) listed in the following table.

The table title is *Pb Flow Rate Completeness,* [date range].

Report Label	Database Mapping		Notes
	Table or View	Column	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Number Required	n/a	Calculated from Start Date and End Date, 1 per site per year	See section 4.12.1.
Number Submitted	ACCURACY_DATA	Calculated: count of ACCURACY_DATA dates	See section 4.12.2.
% Complete	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.
Total # of Sites	MONITORS	Calculated: count(distinct monitors)	Value is "NA" for site summaries.
Audits in Quarters 1/2/3/4	ACCURACY_DATA	Calculated: count of ACCURACY_DATA dates	See section 4.12.3. Four quarterly counts are listed, in this format: Q1/Q2/Q3/Q4. Value is "NA" for monitors.

4.12.1   Number of Flow Rate Audits Required (Pb)

Each Pb monitor must have at least one flow rate audit per year, and each reporting agency must conduct at least one flow rate audit per quarter for each monitor type group. If an agency has fewer than four Pb monitors in a monitor type group, it must conduct multiple flow rate audits of Pb monitors in the group in order to satisfy the one-audit-per-quarter requirement.

4.12.1.1   For a Site

One flow rate PE check is required per monitor per year. If the report date range includes a partial year, AMP255 rounds up to a whole year.

$$\begin{array}{l} Number\ \ Required \\ Flow\ \ Rate\ \ Audits\ _{Site} \end{array} = \mathrm{ceil}\left(\frac{\mathrm{count}\ (quarters\ \ in\ report\ \ date\ range\ )}{4} \right) \qquad (66)$$

4.12.1.2   For a Monitor Type Group

The larger of one flow rate PE check per monitor per year or one per calendar quarter is required per monitor type group per agency.

$$\begin{array}{l} Number\ Required \\ Flow\ Rate\ Audits_{Group} \end{array} = \max\left(\begin{array}{l} \mathrm{count}(quarters\ in\ report\ date\ range), \\ \displaystyle\sum_{Sites} Number\ Required\ Flow\ Rate\ Audits_{Site} \end{array} \right) \qquad (67)$$

4.12.2   Number of Flow Rate Audits Submitted (Pb)

4.12.2.1   For a Site

The number of flow rate PE checks performed by a Pb monitor is the number of distinct dates (ACCURACY_DATA.ACC_DATE) on which flow rate PE checks were performed for that monitor during the time period of the report. The pertinent rows of table ACCURACY_DATA are selected with these conditions:

- ACC_DATE within the range *Start Date* through *End Date*
- AUDIT_CLASS = 'FLOW'
- ACT_ACC_TYPE = 'PE'

4.12.2.2   For a Monitor Type Group

The number of Pb flow rate PE checks submitted for a monitor type group is the sum of monitor counts for the corresponding monitor type group and reporting agency.

4.12.3   Number of Audits by Quarter (Pb)

The column labeled *Audits in Quarters 1/2/3/4* lists the number of flow rate PE checks submitted in each calendar quarter for a monitor type group. (For a site, the value is "NA".) The four quarterly counts are separated by slashes:

$$AuditCount_{Q1}/AuditCount_{Q2}/AuditCount_{Q3}/AuditCount_{Q4}$$

The number of "audits" in a quarter is the number of distinct dates on which flow rate PE checks were performed by monitors comprising the monitor type group. For example, the number of PE checks in the first quarter is the number of distinct dates (ACC_DATE) in ACCURACY_DATA rows having QTR_REPRESENTED=1. The sum of the four quarterly counts is the total number of PE checks submitted for the monitor type group (section 4.12.2.2).

Audits in Quarters 1/2/3/4 consists of four counts, regardless of the time period of the report. If the time period is less than one year, counts for the excluded quarters are zero. If the report time period is more than one year, the counts for some quarters include audits submitted in multiple years. For example, if the report time period were 2003-Q1 through 2004-Q2, the audit counts for quarters 1 and 2 would be totals of 2003 and 2004 audits, while the audit counts for quarters 3 and 4 would represent 2003 audits only.

4.13 Lead (Pb) PE Check Completeness

The AMP255 output table summarizing completeness of analytical PE checks for Pb monitors includes the fields (report columns) listed in the following table.

The table title is *Pb Filter Strip Completeness,* [date range].

Report Label	Database Mapping		Notes
	Table or View	Column	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code
State	STATES	STATE_ABBR	State postal abbrev.
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Monitor Type	MONITOR_TYPE_ ASSIGNMENTS	MT_MONITOR_TYPE	See section 4.1.1. "Highest" of {PAMS > unofficial PAMS > SLAMS > NAMS} or most recent of "other" types.
Site ID	SITES	CC_CN_STT_STATE_CODE || CC_CN_COUNTY_CODE || SITE_ID or "TT" || TA_TRIBAL_CODE || SITE_ID	See section 4.1.2. Value is "NA" for group summaries.
Start Date	SAMPLE_ PERIODS	SAMPLING_BEGIN_ DATE	Monitor start date or "NA" for group summaries. See section 4.1.3.
End Date	SAMPLE_ PERIODS	SAMPLING_END_ DATE	Monitor end date or "NA" for group summaries. See section 4.1.4.
Audits Required (Level 1, Level 2)	n/a	Calculated from Start Date and End Date, 3 per site per quarter	See section 4.13.1.
Audits Submitted (Level 1, Level 2)	ACCURACY_DATA, ACCURACY_AUDITS, AUDIT_LEVELS, QA_DETAILS	Calculated: count ACCURACY_AUDITS rows	See section 4.13.2.
% Complete (Level 1, Level 2)	n/a	Calculated as percent: Number Submitted / Number Required	See section 4.1.5.

4.13.1 Number of PE Checks and Audits Required (Pb)

A PE check for a Pb monitor is really a check of the laboratory performing the Pb analyses for a monitor, but it is treated like a check of the monitor. A PE check involves analysis of six audit samples. Each sample is a strip of filter material containing a known amount of Pb, in one of these two concentration ranges:

- Level 1: $0.5 – 1.5 \ \mu g/m^3$ ($100 – 300 \ \mu g$ per strip)
- Level 2: $3.0 – 5.0 \ \mu g/m^3$ ($600 – 1000 \ \mu g$ per strip)

An analytical PE check is required in each calendar quarter that a laboratory analyzes Pb samples. For this report, it is assumed that laboratory analyses are performed in each quarter that a monitor operates. AMP255 counts the number of quarters in which a Pb monitor was active during the time period of the report. The number of active quarters is the required number of PE checks. A check consists of three audit

samples in each concentration range, for a total of six audits. The report output table lists the required number of audits for each range (Level 1, Level 2) separately, although the two numbers are always equal.

For a Pb monitor, the number of analytical PE checks required is the number of whole and partial quarters the monitor was active (had a sampling period) during the time period of the report.

$$Number\ Audits\ Required_{Site} = \mathrm{ceil}\left(\frac{\mathrm{months\_between}(EndDate+1, StartDate)}{3}\right)\ (68)$$

For a monitor type group, the required number of audits is the sum of required audits for the monitors that comprise the group.

4.13.2   Number of PE Audits Submitted (Pb)

The report output table lists the number of PE audits submitted for each of the two concentration ranges, Level1 and Level 2.

4.13.2.1   For a Site

The number of analytical PE audits performed (submitted) for a Pb monitor is the number of rows present in table ACCURACY_AUDITS for that monitor during the time period of the report. For each PE check, represented by a row of table ACCURACY_DATA, there are linked (related) rows in tables ACCURACY_AUDITS, AUDIT_LEVELS, and QA_DETAILS. The number of related ACCURACY_AUDITS rows is the number of audits associated with a PE check, and the related AUDIT_LEVELS rows give the concentration range of each audit. The related QA_DETAILS rows give the indicated and actual concentration values of each audit.

$$Number\ PE\ Audits\ Submitted_{Site} = \mathrm{count}(ACCURACY\_AUDITS\ \mathrm{rows})\qquad (69)$$

The pertinent rows of table ACCURACY_DATA and related tables are selected with these conditions:

- ACC_DATE within the range *Start Date* through *End Date*
- AUC_AUDIT_CLASS = 'ANALYTICAL'
- ACT_ACC_TYPE = 'PE'
- LEVEL_NUM = { 1, 2 }

4.13.2.2   For a Monitor Type Group

The number of Pb PE audits submitted for a monitor type group is the sum of site counts for the monitors that comprise the group.

$$Number\ PE\ Audits\ Submitted_{Group} = \sum_{Sites} Number\ PE\ Audits\ Submitted_{Site}\qquad (70)$$

4.14 Reporting Agencies

The AMP255 output table that identifies reporting agencies includes the fields (report columns) listed in the following table. This table includes every agency listed in the report tables that summarize completeness, precision, and accuracy of quality indicator data.

The table title is *Reporting Agencies,* [date range].

Report Label	Database Mapping		Notes
	Table or View	**Column**	
Region	STATES	EPAR_EPA_REGION_CODE	EPA region code or "Multiple" if the agency occurs in multiple regions
State	STATES	STATE_ABBR	State postal abbrev. or "Multiple" if the agency occurs in multiple states
Reporting Agency	AGENCY_ROLES	SA_AG_AGENCY_CODE	AQS reporting agency code
Reporting Agency Name	AGENCIES	AGENCY_DESC	Name or description of reporting agency