CALIFORNIA
AIR RESOURCES BOARD

STANDARD OPERATING PROCEDURES
FOR
DATA REVIEW AND VALIDATION

AQSB SOP 610

Third Edition

MONITORING AND LABORATORY DIVISION

November 2019

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CALIFORNIA
AIR RESOURCES BOARD

Approval of Standard Operating Procedures (SOP)

Title:	Data Review and Validation
SOP:	AQSB SOP 610, Third Edition
Section:	Operations and Data Support Section
Branch:	Air Quality Surveillance Branch (AQSB)
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Table of Contents

Page

FIGURES

TABLES

APPENDICES

REVISION HISTORY

Edition	Release Data	Changes
First	Feb 2015	New Document
Second	Mar 2016	Added Data Quality Activities Section Added Correcting Data Post AQS Submittal Section
Third	Sep 2019	ADA Remediation Add Data Systems and Handling Section Add ODSS Data Review Section Add Critical and Operational Criteria Validation Section Add additional information regarding AQDAs and CANs Add Zero Qualification for Calibration Zero Air Systems

LIST OF ACRONYMS

ARB - Air Resources Board
AMNS - Air Monitoring North Section
AMSS - Air Monitoring North Section
APICOM - Interface utility by TAPI to access internal instrument data.
AQDMS - Air Quality Data Management System Team
AQMIS - Air Quality and Meteorological Information System
AQPSD - Air Quality Planning and Science Division
AQS - Air Quality System
AQSB - Air Quality Surveillance Branch
BAM - Beta Attenuation Method
CARB - California Air Resources Board
CFR - Code of Federal Regulations
CH4 - Methane
CL - CARBLogger
CO - Carbon Monoxide
COC - Chain of Custody
CPU - Central Processing Unit
DAS - Data Acquisition System
DMS - Data Management System
DFU - Dry Filter Unit
FEM - Federal Equivalent Method
FRM - Federal Reference Method
FRV - Flow Rate Verification
GPT - Gas Phase Titration
HC - Hydrocarbon
LC - Local Conditions
LPM - Liters per Minute
LST - Local Standard Time
MFC - Mass Flow Controller
MFM - Mass Flow Meter
MLD - Monitoring and Laboratory Division
MO - Monitoring Organization
NLB - Northern Laboratory Branch
NIST - National Institute of Standards and Technology
NO - Nitric oxide
NOx - Nitrogen oxides, used here as the sum of NO and NO_2
NO2 - Nitrogen dioxide
ODSS - Operations and Data Support Section
Op - Operational
O3 - Ozone
PMT - Photo Multiplier Tube

ppb	- parts per billion
ppm	- parts per million
PQAO	- Primary Quality Assurance Organization
PST	- Pacific Standard Time
QA	- Quality Assurance
QAPP	- Quality Assurance Program Plan
QAS	- Quality Assurance Section
QC	- Quality Control
QMB	- Quality Management Branch
Q_{tot}	- Total volume sampled in m^3
SFTP	- Secure Fire Transfer Protocol
SLPM	- Standard Liters per Minute
STP	- Standard Temperature and Pressure
SOP	- Standard Operating Procedure
TAPI	- Teledyne Advanced Pollution Instrumentation
THC	- Total Hydrocarbons
Thermo	- Thermo Electron Scientific
U.S.EPA	- United States Environmental Protection Agency
UCT	- Universal Coordinated Time
UV	- Ultra Violet

1.0 GENERAL INFORMATION

1.1 Introduction:

The California Air Resources Board's (CARB) ambient air monitoring program collects accurate real-time measurements of ambient level pollutants throughout California. The goal of the program is to collect data of sufficient quantity and quality to meet the objectives of its intended use. The program is designed to help define the nature and severity of pollution in California, determine attainment status with California Ambient Air Quality Standards (CAAQS) and National Ambient Air Quality Standards (NAAQS), identify pollution trends, support agricultural burn forecasting, provide real-time air quality information, assess community exposure, and validate air quality models and emission inventories. These data are also used to support other programs conducted by CARB and affiliated Primary Quality Assurance Organization (PQAO) members.

This Standard Operating Procedure (SOP) contains guidelines for performing data review, verification, and validation of data generated by continuous monitors or instrumentation used within CARB's ambient air monitoring network.

The purpose of this document is to outline how CARB's ambient air monitoring staff are to review, verify, and validate ambient air quality data before releasing the data for use by end-users. These procedures can be adopted by other monitoring organizations (MOs) with any differences documented in an addendum.

Note: Data validation procedures for data generated from filter-based monitors and/or manual samplers are not covered by this SOP. Users should refer to CARB Particulate Matter Quality Assurance Program Plan, United States Environmental Protection Agency (U.S.EPA) data validation templates for filter-based samplers, or SOP's specific to filter-based monitors for data validation guidance of those data sets.

1.2 Responsibilities:

CARB has established a multi-level data review process which incorporates the concepts of review, verification, and validation. These terms are defined as:

Review – examination of data to ensure that data has been recorded, transmitted, and processed correctly.

Verification – evaluation of a specific data set or packet to ensure that it is complete, correct, and compliant against established specifications.

Validation – an analytic and sample specific process that extends beyond the data verification to determine the quality of data relative to the end use.

The data review process consists of three independent levels: the first level with the site operator, the second level with the site secondary data reviewer (typically another air monitoring lead), and the third level with the management. Data reviewers should perform data review for their designated level according to the guidelines provided in this SOP.

The following is a generic list of tasks data reviewers are expected to demonstrate proficiency:

- Be able to identify typical daily and seasonal concentration variations with gaseous pollutants.
- Be able to identify instrument malfunctions associated with characteristic data irregularities.
- Be able to identify cyclical or repetitive data variations.
- Be able to identify data patterns indicating a loss of sensitivity, flow issues, or system leaks.
- Have a good understanding on the relationship of one gaseous parameter to another, (e.g. ozone and NOx).
- Understand instrument's zero/span and precision calibration results and be able to identify for any performance shifts.
- To review and compare data from "buddy" sites or collocated data sites.
- To recognize for any abnormal local events that may influence data.
- To review the graphical data displays for any data spikes.
- To review data capture rates to ensure completeness criteria are met.

1.3 Data Review Tools:

It is important to gather all relevant sources of information related to the data and their instruments, as they are the primary tools we will use for data review and validation. Well-organized documentation eases the review and validation process and saves time for reviewers.

These information sources include but are not limited to, station logbooks, monthly quality control (QC) forms, multi-point calibration results, auto-QC check control charts, audit results and data correction documents.

2.0 DATA SYSTEM AND HANDLING

The data systems primarily utilized by CARB for the ambient air monitoring network and data handling process are: 1) the data acquisition system CARBLogger, and 2) the data management system DMS. Their specific user SOP's (AQSB SOP 605 for the CARBLogger and AQSB SOP 606 for the DMS) are available on the CARB's website at CARB Ambient Air Monitoring SOP's.

2.1 Data Security and Chain of Custody:

A. Data Security

Access to CARB's data management system is only provided to CARB staff with a need to use the system. Initially a user will log onto the CARB domain with a unique password. The password to the CARB domain is required to be updated every 90 days. To use the DMS system, users are provided with a DMS account which includes a login ID and password. All users with an account on the DMS, at a minimum, are granted public access. A public account allows a user to view all data but no data edit rights. Users with data edit rights can make changes to data, which are recorded in the systems chain of custody with the date and initials of the editor. To prevent unauthorized edits, DMS further limits the ability of data editors by only allowing a user to edit sites/monitors for which they are responsible. Only staff directly involved in CARB air monitoring operations (Air Quality Surveillance Branch) have edit rights on DMS.

B. Chain of Custody

Once data are transmitted to DMS, all changes to data are tracked via the system Chain of Custody (COC) feature. Modifications made to data by any user are retained in the COC table. The COC table tracks the following entries:

- QC check date and time.
- Name of the user who modified the data.
- Target site, parameter, instrument model, and data record date & time.
- New value, new QC code, new Operational (Op) code, and new Null code.
- Old value, old QC code, old Op code, and old Null code.
- Comments (notes added when data changes are saved).
- Automated QC check type, test site, parameter, and value.

2.2 Data Handling Process:

The data handling process involves collecting ambient air quality data from air monitoring locations, transmitting the data to headquarters in Sacramento, and ingesting the data into a central database. Real-time data are QC screened automatically before transmittal to real-time clients. Data for-record require multi-level review and validation before transmittal to U.S.EPA's Air Quality System (AQS).

The figure below outlines the data process from data collection, transmission, storage, multi-level review, validation, and submission.

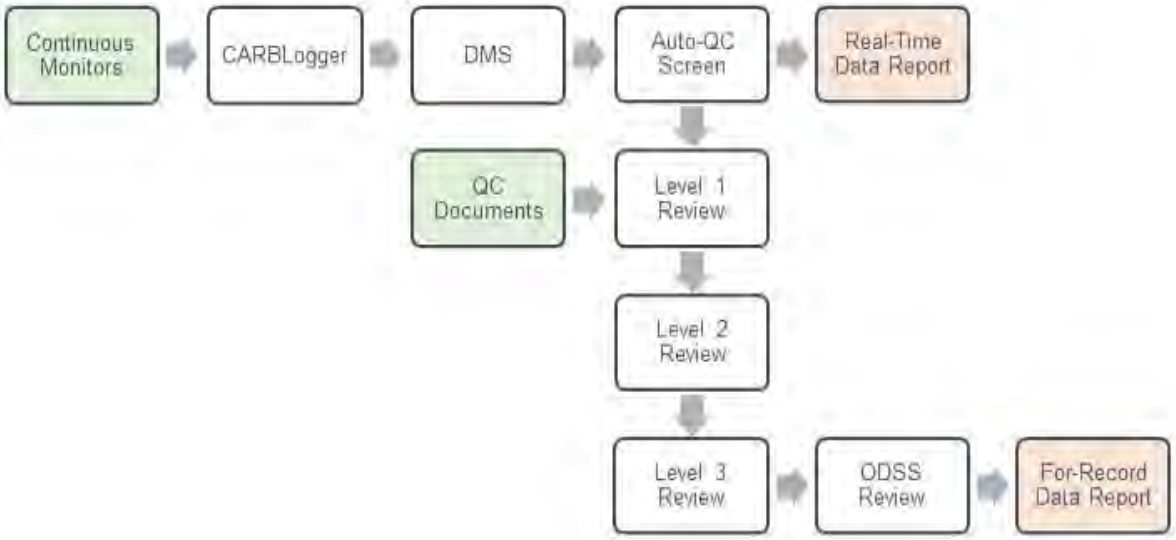


Figure 2.2: CARB Data Handling Process

2.3 Data Acquisition System:

CARBLogger is a Linux based data acquisition system developed by CARB's Operations and Data Support Section (ODSS) and is used at monitoring stations to collect data from the connected instruments and analyzers and to record these raw conversations into formatted data files.

Twice an hour, CARBLogger generates a data file and sends data from field monitoring locations to CARB's Secure File Transfer Protocol (SFTP) Server.

Another feature of the CARBLogger is to monitor instruments and analyzers for any alarm condition and send email notifications to inform the site operator, second level reviewer, and section manager of alarm conditions it detects.

Since most of the on-site analyzers, except for those meteorological instruments, come with onboard memory, data can be backpolled and reprocessed for transmittal, in event of communication issues in the field.

2.4 Data Management System:

CARB's back-end data system, Data Management System (DMS) is a Microsoft SQL server database. It resides on a virtual server maintained at California's State Tier 1 data center. DMS manages and processes air quality and calibration data received from the field. DMS screens incoming data and applies automated QC to the data to assist in data reporting.

Site operators and data reviewers can review and edit these air quality data on their PC workstations via the DMS terminal server.

2.5 Data Channel Status on CARBLogger:

Site maintenance or other activities (e.g. repair, testing, audit, calibration, etc.) can compromise the quality of data collected by any single instrument. It is imperative that site operators mark down affected data channels during such activities. This will allow DMS to flag data correctly based on the channel status, and prevent reporting erroneous data to the public. DMS calculates hourly data by averaging all valid minute values collected during an hour. A failure to disable instruments when performing maintenance, calibration or other activities can result in false calculations by DMS.

CARBLogger allows site operators to enable/disable data channels via the interface. For details, refer to section 3.7 of the CARBLogger SOP.

2.6 Data Flagging:

DMS distinguishes the validity of air quality data by the use of Op code and QC code. The Op code is DMS data flag assigned to data point denoting the operational status of the instrument. The QC code is DMS flag denoting the validity of a data point. Data flagging is the process of assigning an Op and/or a QC code(s) to the data point in order to communicate data quality, validity and status.

CARBLogger allows data flagging in two manners:

Manual Data Flagging – site operator can manually mark down a data channel on CARBLogger during instrument maintenance or calibration, and data for that channel will be flagged with the correct Op code accordingly.

Automated Data Flagging – CARBLogger is programmed to flag data from calibrations automatically. Instrument configuration settings can be used to interpret effects of gas calibrator on the quality of the data and assigns each data point an appropriate data flag.

For additional information about data flagging, refer to section 5 of the CARBLogger SOP.

3.0 DATA REVIEW

3.1 Overview:

Ambient air monitoring data shall be reviewed for quality and acceptability based on the method, instrument analysis procedures, quality control requirements, and calibration procedures detailed in appropriate instrument SOPs and QA documents, e.g., the Quality Assurance Program Plan (QAPP).

The metrics to review shall include, but are not limit to, data capture, precision, bias/accuracy, and the amount of precision and bias/accuracy data collected and reported.

CARB currently utilizes three data review levels in the data review process. The ODSS also performs additional checks for conformity before AQ data can be submitted to AQS. Descriptions for each review level is included in the later sections of this document.

In order to submit data to AQS in a timely manner, CARB uses a data review schedule to keep all levels apprised of their deadline for pushing reviewed data to the next level. A sample data review schedule is illustrated in Appendix A1.

3.2 First Level Review:

First level review process is typically performed by the site operator, which will be identified as the first level reviewer. First level review is considered the most important step in the process as the site operator is the one who is most familiar with day-to-day monitoring operations. The first level reviewer should review preliminary data on a regular basis to confirm normal operation of instrument analyzers, identify any missing or erroneous data values, out-of-range conditions, and take corrective action in a timely manner when required.

This level of review includes review of data flagged for outliers, maximum and minimum values, consistently repeating data values, and auto-flagged data on DMS. The reviewer shall distinguish valid measurements from indications caused by malfunctioning instruments or source interference, such as, roofing, gasoline vapors, or structure fires, etc.

The first level reviewer shall document station operation actions, and prepare and submit monthly data submittal for each responsible site ensuring that the data review meets all first level criteria. The monthly data submittal shall include a copy of the calibration control chart for each gaseous parameter, a Monthly Quality Maintenance Check Sheet for each available instrument analyzer, a copy

of the station logbook, a data capture report and an invalid data summary page for that site. It is recommended that other documentation that may aid in data review process be included in monthly data submittals. Examples of other documentation may include calibration and audit reports, e-mails related to site operations or other information the first level operator considers important for data review.

3.3 Second Level Review:

Second level data review is performed by a secondary site staff or another member in the section, which will be identified as the second level reviewer hereafter. The second level review verifies the work performed by the first level reviewer. In addition, the second level reviewer needs to ensure that data collected meets requirements outlined in the Code of Federal Regulations (40 CFR 58 Appendix A), to be deemed valid data for record. The second level data review is more site specific focusing on diurnal and seasonal trends surrounding high/low values and exceedances. Moreover, the reviewer needs to confirm that all the QC practices were performed to meet the data quality objectives for each pollutant or parameter.

The second level review process includes review of the monthly data report generated from the first level, the monthly data exceedance report, the flowrate verification report, the data completeness check, data locking (for hourly data in DMS), and buddy site comparisons for all suspect data values and/or null coded data.

The second level reviewer will need to prepare and summarize this data package before submitting it to CARB management. Any significant issues or data anomalies from the site shall be highlighted and described in sufficient detail. For example, any interruptions of data that are at least 24 consecutive hours in duration should be documented on the cover page.

3.4 Third Level Review:

The third level review is considered a management level review. Typically, the air monitoring section manager reviews all the documents submitted to ensure that the data are accurate and complete, sites have been maintained properly, instruments are operating within acceptable criteria, and all maintenance and repair actions are fully met and documented. If the section manager has any concerns regarding the site and its data, they should immediately address the issue and take corrective action.

The section manager should assemble monthly data submittal packages for

their responsible sites and submit via a signed cover memo to the Branch Chief. The data package should include all site monthly data reports (i.e. control chart, data capture report, instrument check sheet, and station log), all site/parameter monthly data summaries, all PM instruments flowrate verification report, and a brief summary of any event out of the ordinary (or exception event) that disrupts the collection of quality data from each site.

The Branch Chief should review and initial the cover letters with all the attached documents signifying approval of the data for public release. The Branch Chief should also perform some high-level inquiry or random spot checks on the monthly data packets occasionally, to ensure that results are consistent and accurate.

Finally, the Branch Chief should forward the approved data package to the ODSS manager for data submission to AQS.

3.5 Operations and Data Support Section Review:

Once the data package is forwarded to ODSS, a conformity check is performed on the data package and the related data in DMS. This high-level screening serves as a final inspection to ensure that all data have been reviewed, validated and locked in the data system. The ODSS also reviews all monthly data packages for completeness according the established guidelines; no missing instrument report and all notable data disruptions for the reporting month are recorded properly both on paper and DMS.

The screening includes, but not limited to, checking for the data package completeness, checking for signatures from all reviewers, confirming any documented data loss to match on DMS, checking for null-code on all flagged data, and checking for the review and lock status on all reportable data, etc.

Once data passed the screening, ODSS will generate the required AQ and QC data files, i.e., the reviewed concentration data, the 1-Pt QC data, and the Flow Rate Verification (FRV) data, for AQS submission.

After data submission, ODSS archives all data packets and related documentations according to CARB's data retention policy. The current data retention requirement for CARB is a total of seven years (three years of office storage before additional four years of long-term archive). This retention policy is important for any future corrective action requests.

On a quarterly basis, ODSS inspects and reviews CARB data submitted to AQS to ensure the completeness of submission. Staff can utilize many AQS-provided

report templates to review for data quality. These reports include, but are not limited to:

- AMP 256 – Data Quality Indicator Report
- AMP 350 – Raw Data Report
- AMP 360 – Raw Data Qualifier Report
- AMP 390 – Monitor Description Report
- AMP 430 – Data Completeness Report

4.0 DATA VERIFICATION AND VALIDATION

4.1 Overview:

Data review, verification and validation are techniques used to accept, reject, or qualify data in an objective and consistent manner. Data verification can be defined as confirmation that *specific requirements* (instrument checks, QC activities, maintenance events etc.) have been fulfilled. Data validation can be defined as confirmation of particular *requirements for a specific intended* use are fulfilled.

For example, checking a monthly dataset to verify that ozone precision checks are done at least once every 14 days is data verification. Checking the ozone precision checks against the QC acceptance criteria to determine if the collected data are valid or compromised is data validation.

Data validation criteria, validation protocols for data reviewers, automated QC screening, coding used for data validation, and information related to the data editing process are described in the following sections.

4.2 Data Validation Criteria:

Basics of QC Checks

Quality Control is composed of a set of internal tasks performed routinely to ensure representative, high quality and defensible ambient air quality data. These tasks address all aspects of monitoring and reporting. Examples include automated calibration, instrument diagnosis, preventative maintenance, data review, and documentation.

For gaseous pollutant instruments, CARB conducts QC checks using automated calibration systems to confirm an instruments ability to respond to known concentrations of gas. These checks are conducted several times per week at zero, precision, and span level concentrations. Precision level checks generated during automated calibrations represent the required one-point QC check as required in 40 CFR, Part 58, Appendix A. In addition, these QC checks are used to generate control charts to assess instrument drift and verify that instruments operated within acceptable control limits.

Failure to conduct or pass a required check or procedure does not itself invalidate data for regulatory decision making. Reviewers can still use the check or procedure in combination with other data, reports, and similar documentation to demonstrate overall compliance. If any QC checks are

found to be outside of the acceptance criteria, a weight of evidence evaluation shall be performed. Please note that QC checks solely are not used to make any adjustments to instruments, doing so will invalidate the multi-point calibration of the instrument.

The degree of variability in each of these measurements is computed as the precision of those instruments' measurements. Routine QC checks are performed using calibration equipment and standards separate from those used for the multi-point verifications or calibrations.

Site operators, data reviewers, and air monitoring management monitor the results of quality control checks and take action if the results fall outside of acceptable limits.

Zero, Precision and Span QC Check Acceptance Criteria

To assess the quality of gaseous 1-point QC checks, CARB has established the following QC control limits in the network (warning and action limits) based on the results of automated zero, precision and span checks.

For precision/span checks:

- Warning level: ± 5% for all gaseous instruments.
- Action level: ± 7.1% for O3; +/- 10.1% for CO and SO2; ± 15.1% for NO2.

For zero checks:

- Zero drift: < ± 3.1 ppb (24hr) or < ± 5.1 ppb (>24hr-14 day) for O3, NO2, and SO2.
- Zero drift: < ± 0.41 ppm (24hr) or < ± 0.61 ppm (>24hr-14 day) for CO.

If precision and span QC checks are less than ± 5%, and zero checks are less than values stated above, it can be assumed that instruments are operating properly and no corrective action is required.

The "warning level" is reached when the QC check response of any gaseous analyzer varies by more than ± 5% from the expected value. At this level, instrument performance should be closely monitored and/or corrective action taken before the analyzer reaches the action level.

The "action level" is reached when the QC check response for ozone varies more than ± 7.1%, carbon monoxide or sulfur dioxide vary more than ± 10.1%, or nitrogen dioxide varies by more than ± 15.1%. When the action level is reached, corrective action **MUST** be initiated and documented.

Table 4.1: One-Point QC Check Acceptance Criteria

Pollutant	One-Point QC Check (Action Level)	Zero/Span Check (Action Level)
Ozone	<± 7.1% difference or <± 1.5 ppb difference whichever is greater	Zero Drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14day) Span Drift ≤±7.1 %
Carbon Monoxide	<± 10.1 % difference	Zero Drift < ± 0.41 ppm (24 hr) < ± 0.61 ppm (>24hr-14day) Span Drift ≤ ±10.1 %
Sulfur Dioxide	<± 10.1 % difference or <± 1.5 ppb difference whichever is greater	Zero Drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14day) Span drift ≤±10.1 %
Nitrogen Dioxide	<± 15.1 % difference or <± 1.5 ppb difference whichever is greater	Zero Drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14day) Span Drift ≤±10.1 %

Precision is based on one-point QC checks for gaseous instruments. For precision, the statistic is the upper bound of the coefficient of variation (CV), which reflects the highest estimate of the variability in the instrument's measurements. One-point QC checks for gaseous instruments are also used to estimate bias. The precision and bias calculations are based on requirements in 40 CFR 58, Appendix A.

Table 4.2: Precision and Bias of One-Point QC Checks

Pollutant	Precision	Bias
Ozone	90% CL CV <7.1 %	95% CL <±7.1 %
Carbon Monoxide	90% CL CV <10.1 %	95% CL <±10.1 %
Sulfur Dioxide	90% CL CV <10.1 %	95% CL <±10.1 %
Nitrogen Dioxide	90% CL CV <15.1 %	95% CL <±15.1 %

Table 4.3: Continuous PM QC Criteria

Parameter	Frequency	Acceptance Criteria
Data Reporting Period	Report every hour	24 hour period is calculated in AQS if 18 or more valid hours are reported for a day
One-point Flow Rate Verification	Every 30 days each separated by 14 days	< ± 4.1% of transfer standard
Leak Check	Bi-weekly	< 1.0 LPM (BAM)
Ambient Temperature. Sensor	Bi-weekly	± 2.0 Degrees Celsius
Ambient Pressure Sensor	Bi-weekly	± 10 mm Mercury
Clock	Bi-weekly	± 2 minutes of standard

Table 4.4: Continuous PM Calibration Criteria:

Parameter	Frequency	Acceptance Criteria
Flow Rate Calibration	Any electromechanical maintenance, transport or every six months	< ± 2.1% of transfer standard
Temperature Calibration	Any electromechanical maintenance, transport or every six months	± 2.1 Degrees Celsius
Pressure Calibration	Any electromechanical maintenance, transport or every six months	± 10 mm Mercury
Leak Check	Any electromechanical maintenance, transport or every six months	< 1.0 LPM (BAM)
Clock	Any electromechanical maintenance, transport or every six months	± 1 minute of standard

Additional Validation Criteria

To assist MOs to develop their Quality Assurance Project Plan and validation criteria, U.S. EPA has published measurement quality objectives and validation templates in the EPA's 'Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Management Program', Appendix D (March 2017). CARB has adopted the specific measurement quality objectives presented in the validation template with some exceptions, and documented the differences in the 'Quality Assurance Program Plan for

Gaseous Pollutant Air Monitoring Program' (September 2018).

U.S. EPA's validation templates document download link:
US EPA Data Validation Templates

CARB's Gaseous QAPP document download link:
CARB Gaseous QAPP

U.S. EPA Data Validation Criteria:

- critical criteria
- operational criteria
- systematic criteria.

Critical criteria are criteria for regulatory monitoring that are deemed critical to maintaining the integrity of a sample or group of samples. Observations that do not meet each and every criterion listed in this category should be invalidated unless there are compelling reason and justification for not doing so.

Criteria that are important for maintaining and evaluating the quality of the data collection system are included under **Operational Criteria**. Violation of a criterion or a number of criteria may be cause for invalidation (but not an automatic invalidation). The decision maker should consider other quality control information that may or may not indicate the data are acceptable for the parameter being controlled. The reason for not meeting the criteria must be investigated, mitigated or justified.

Finally, those criteria which are important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples are the **Systematic Criteria**. However, not meeting the systematic criteria may cause uncertainty and become a basis for invalidation of all associated data.

4.3 Critical and Operational Criteria Validation:

Quality control checks are typically performed in an automated manner and as such are designed to aid but not replace our data review process. Prior to invalidating data based on QC checks, a process known as "validation before corrective action" should be implemented.

Validation before corrective action means that calibration staff (staff independent from the site operator) using certified transfer standards, verifies that QC check results are valid and are not simply caused by a problem with the calibration system (i.e. faulty ozone generator or zero air supply). If it is

determined, that an instrument has malfunctioned or instrument drift has occurred causing the instrument to drift outside of acceptable criteria, corrective actions must be taken to bring the instrument within acceptable control limits. Data collected after periods where QC criteria has been exceeded should be invalidated (or flagged in some cases) unless there are compelling evidence for not doing so. Compelling evidence are such as, an independent audit, a multi-point verification, instrument diagnostic data, buddy site comparisons, etc. that can help to establish whether an analyzer was in fact operating within criteria limits.

Should there be a cause for data invalidation, the range of data to be invalidated shall be determined appropriately so that valid data is not scarified.

Instruments Critical Criteria (One Point QC Check Accuracy)

Gaseous instruments must meet the QC acceptance criteria stated in the previous section. When a one point QC check indicates that an instrument has drifted outside of acceptable limits, data collected after that QC check should be considered invalid unless there are compelling reasons and justification for not doing so. Should those data be validated, data reviewers should provide clear and adequate documentation to explain their compelling reasons and justification.

Instruments Critical Criteria (One Point QC Check)

Gaseous instruments used in the network require a one point QC check at a minimum every 14 days. Under normal conditions, CARB conducts gaseous one point QC checks multiple times per week. However, there may be times where a one point QC check is not completed (i.e. calibration system failure, gas standard empty etc.). Should a period of more than 14 days exist where no one point QC check is performed but data are considered valid, data should be flagged with the AQS Qualifier code, (1- Deviation from Critical Criteria). The data flag range should cover the period beginning the first day after the missed 14 day QC check period until the next valid one point QC check is accomplished.

For example, a one point QC check is performed on the 3rd day of the month and the next check is performed on the 28th day of the month. Assuming data are determined to be valid, the AQS qualifier code, (1-Deviation from Critical Criteria) should be applied to the data collected between the 18th day of the month through the 27th day of the month.

Instruments Critical Criteria (Flow Rate Verification)

Continuous particulate monitors must undergo a flow rate verification (FRV) at a minimum every 30 days with each FRV separated by 14 days. Additionally, the QC acceptance criteria for each FRV is < + 4.1% of transfer standard value.

Under normal conditions, CARB conducts bi-monthly FRV's on all continuous particulate matter (PM) monitors. The FRV check serves as the one point QC check for continuous PM monitors and is required to be reported to AQS. **NOTE: CARB uses the same FRV QC acceptance criteria for continuous PM10 and PM2.5 monitors.**

In the event that a FRV fails QC acceptance criteria for flow rate (flow is greater than 4.1%), data collected back to the last valid FRV check are considered invalid. Data reviewers should use the most appropriate null data code when invalidating data due to failed flow checks. No data should be collected until the flow deviation is resolved. Data reviewers should provide clear and adequate documentation to explain the invalidation.

In the event that a FRV is not completed on a particulate monitor within a 30 day period, but data are considered valid, data should be flagged with the AQS Qualifier code, (1- Deviation from Critical Criteria). The data flag range should cover the period beginning the first day after last FRV check until the next valid FRV check is accomplished.

Instruments Operational Criteria (Shelter Temperatures)

Gaseous instruments used in the network are maintained within environmentally controlled shelters. The acceptable range for monitoring shelters is between 20°C and 30°C. However, per manufacturers' specifications, many gaseous instruments have been qualified, and designated to operate at wider temperature ranges. It is acceptable to use a wider operating temperature range if specified by the manufacturer. Should the operating temperature range of instruments be exceeded, it is important to closely evaluate other instrument diagnostic parameters to determine data validity.

Air monitoring instrumentation must be operated within the temperature range for which they were designated to be considered FRM/FEM. For CARB sites, instrument temperature ranges are typically based on the hourly box or instrument temperature readings. If it is determined that data is valid, but collected when instrument operating temperature limits are exceeded, data should be flagged with the AQS Qualifier code, (2-Operational Deviation).

4.4 Auto QC Screening:

To improve the efficiency of data validation and to ensure that the best possible real-time data are reported, CARB utilizes automated quality control checks (Auto QC Screening), to apply flags to data based on a series of screening criteria.

The Auto QC Screening criteria are applied to hourly data after they are aggregated from incoming 1-minute data records. The process does not alter hourly data values, and would only change the data points' corresponding flag. All changes made to a data points' QC code are recorded in the DMS chain of custody (COC).

The following criteria are typically used in the screening process:

- "Max suspect" and "max severe" checks apply a QC code of 5 (suspect) or 9 (invalid) respectively, when the hourly value exceeds the set limit.

- "Rate of change check" applies a QC code of 5 (suspect) if the difference between the previous hour and the current hour exceeds the rate of change value.

- "Sticking check" applies a QC code of 5 (suspect) to data that are the same value for the number of hours specified in the (# of sticking hours) column in the DMS auto QC sticking hours setting..

- "Minimum range check" uses the Federal Minimum Detection Limit (Fed MDL) column value to flag hourly values below the negative of the Fed MDL.

In addition, the automated screening process uses the BAM-1020 sampler's Q_{tot} value (total volume sampled in m^3), to validate its corresponding PM concentration data. BAM data outside of the acceptable Q_{tot} limits will be flagged and/or invalidated accordingly.

Note: BAM QC criteria has changed in lieu of BAM-1020 firmware v3.6 release, as specified in the Met One Pressure Drop Setting Technical Bulletin.

Auto QC Screening is designed to aid but not replace the data review process. Therefore, **ALL data auto-flagged by DMS must be verified and/or confirmed using other available information.**

All data flagged as suspect QC (5) must be either validated or invalidated. If it is determined that data are valid, the corresponding QC code should be changed to 0 (valid). If it is determined that data are indeed invalid, the QC code should remain unchanged and an appropriate Qualifier or Null code should be assigned to the data point. BAM data flagged as QC code 4 (suspect, flow rate) should be edited to apply a QA qualifier code (W, flow rate average out of spec) to the associated data point.

4.5 Editing Data in DMS:

Note: The actual steps for editing data on the DMS application are not covered in this section of SOP, but are provided in sections 5.5 and 5.6 of the DMS SOP. This section instead covers the policies for data editing and for using QC/Op/Null/Qualifier codes.

All air quality data submitted to AQS should be fully reviewed and validated through the multi-data review process. Suspect and questionable data should be either validated or invalidated, based on available information, such as results daily QC checks, site operator notes, Auto QC Screening and monthly QC documentation. The information should help to determine the type of data editing required. Data editing typically involves changing the value, QC code, Op code, Null code, and/or Qualifier code associated with those questioned data points.

The terms related to DMS data coding in this SOP are defined as:

Op codes are operational codes that provide information on instrument conditions during field sampling (e.g. when instruments are in self-check or error modes and when calibrations are occurring).

QC codes are quality control codes that provide information on the validity of data (e.g. when a data value is invalid due to insufficient data).

Null data codes are used to provide a reason for missing or invalid data values and go in place of data exported from DMS into AQS.

Qualifier codes are used to describe the condition of the data to be exported to AQS. When a localized or exceptional event or data handling procedure that may affect the data, these codes act as flags to the data and provide information such as quality assurance purposes, describe field issue (i.e. high winds) or may be used to request exclusion for the data being exported to AQS. DMS allows for the use of up to ten qualifier codes to each data point.

Op and QC codes are defined and utilized internally by CARB's data management system to facilitate data screening and to assist reviewers on data review and validation, while Null and Qualifier codes are defined and mandated by U.S. EPA for data submitters to invalidate or qualify the submitted data.

Appendices B1-B3 in this document include the list of Op and QC codes currently available in DMS, as well as a table with the commonly-used qualifier code combinations for typical data invalidations.

For the Null and Qualifier codes, U.S. EPA publishes a full list on the AQS website at, US EPA AQS Code Table.

Generally, data associated with the valid Op and QC codes, (Op Code 0 & QC code 0), are considered valid data and are included in higher-level data aggregation in DMS; no null code nor qualifier code is needed for valid data. Data assigned with any non-valid Op and QC codes are excluded from data aggregation in DMS and are not reported to real-time data clients.

Data collected during the automated checks are assigned Op codes for various stages of the process, (i.e. Op codes: 1-zero, 2-gas precision). Once data are ingested into DMS, each Op code associated with the data will be mapped to QC code during the Auto QC Screening process.

In some cases, data may be flagged suspect. Suspect data are typically flagged by DMS Auto QC routines and require further review. Data editing should be performed to either invalidate or qualify for these suspect data. Suspect data are not reported to real-time data clients.

Data reviewers should use good judgement when selecting the best combination of Op/QC/Null/Qualifier codes to describe any data condition that may arise. To the maximum extent possible, site operators and data reviewers should ensure that null data codes reflect the actual reason for data invalidation. It is advisable to minimize using ambiguous null codes, such as "AL – Voided by Operator" and "AM – Miscellaneous Void". Refer to the appendices B1, B2 and B3 for different data coding and descriptions.

All Op, QC, Null, and Qualifier codes remain with the data in DMS, and Op/QC codes are never included in the data file for AQS submission. Through the bulk null coding feature in DMS, any missing or invalid data points not assigned with a null code should be manually assigned a null code before transmission to AQS.

Any data edits made in DMS will create an "edit trail", which stores information

such as, the original and edited values, the changes to the QC/Op/Null/Qualifier codes, and the reason for the edit. DMS will also time-stamp the entry and note the name of the editor for record.

5.0 FIRST LEVEL DATA REVIEW

First level data review is a microscopic review focusing on the air quality data and calibration/QC data, performed daily by the first level reviewer, typically the site operator. During this data review, the first level reviewer needs to confirm normal operation of monitors and take corrective action in a timely manner, if required. The reviewer should perform a thorough examination of the collected data and determine if those data are reasonable or not, and to invalidate them if outside of the performance criteria and QC limits. All QC data, instrument maintenance records and metadata must be evaluated.

A key component in the first level data review process is to document the data status and all QC activities that occurred at the air monitoring site for that reporting month. The first level reviewer is also responsible for initiating monthly data submittal packet. The monthly data submittal packet includes copies of the calibration control chart for all available gaseous parameters, the monthly maintenance check sheets for all available analyzers, the station logbook, the data capture report for gaseous parameters and a DMS invalid data summary page for that site. This submittal is a critical part of the complete data package assembled by the second level reviewer.

5.1 Preliminary Data Review:

First level reviewers are required to review and/or edit a large amount of raw data, as DMS stores both minute and hourly averages for most parameters. It is recommended that first level data review be conducted on a daily basis.

This section provides some guidelines for ALL data reviewers that can used to aide in understanding data review task.

A. The data reviewer should observe data for outliers, maximum and minimum values, consistently repeating data values, automatically flagged values, and diurnal and seasonal trends.

B. The data reviewer should be familiar with typical diurnal (daily) concentration variations (i.e. the times daily maximum concentrations occur and the inter-relationship of pollutants). For example:

- Carbon monoxide (CO), nitric oxide (NO), and hydrocarbon (HC) concentrations usually increase and decrease together.
- NO and Ozone (O3) cannot coexist at high concentrations.
- Nitrogen dioxide (NO2) and NO concentrations, or their sums, should not be greater than oxides of nitrogen (NOx).

- Methane (CH4) plus non-methane hydrocarbon concentration should not be greater than total hydrocarbons (THC).

C. The data reviewer should be familiar with the type of instrument malfunctions that cause characteristic trace irregularities. For example: broken BAM tape, failed pump from sampler, clogged filter, leak, etc.

D. Cyclical or repetitive variations (at the same time each day or at periodic intervals during the day) may be caused by excessive line voltage or temperature variations. Nearby source activity can also cause erroneous or non-representative measurements and should be properly noted in the station logbook as well as with the use of QC/Op/Null codes.

E. Graphical displays of data on DMS showing little or no activity, other than incorrect graphical display setup, often indicate a loss of sensitivity, flow problems, or sample line leaks.

F. Automated precision and/or span checks provide a means of detecting shifts in instrument performance. If instrument response varies by more than 5% from the expected value, the site operator should be aware and troubleshooting should commence.

G. Data reviewer should perform "buddy-site" comparisons for like parameters between sites within close proximity of each other. Track the diurnal patterns for several days to detect if there are any instrument discrepancies or issues.

H. Data reviewer should compare collocated data, if available. The collocated data should track and compare well; if not, troubleshooting should commence.

I. Data reviewer should continuously review all diagnostic emails automatically sent from the site's CARBLogger. These emails provide information on any alarm conditions present on instrumentation monitored by CARBLogger.

J. For unusually high values, the data reviewer should thoroughly investigate to ensure the analyzer was operating properly and to determine if any abnormal sampling condition was present.

1. The reviewer should:

- Ensure that the analyzer was operating within all established criteria and did not display other signs of malfunctions. Thoroughly review all

available metadata to ensure proper instrument operation.

- Ensure that the nightly QC checks before and after the questionable data were within established criteria. The precision/span checks tracked over the previous week and following week.

- Determine if an abnormal event occurred that might have impacted the data, such as a nearby fire, roadwork, and construction, etc.

2. The reviewer should also investigate to determine if:

   - The data value follows seasonal, diurnal, or historical trends.

   - The data compares to other collocated data, if available. Ex. compare a high ozone value with NO data, or high BAM2.5 to BAM10 data.

   - The data tracks with like parameters from other sites in the "buddy site" comparisons.

   - The data does not appear as an anomalous spike when graphically displayed. The data suddenly ramps up to or down from the questionable data.

   - The questionable data is less than three times the typical monthly maximum when compared to historical data, taking into account the season and time of day.

   - Neither the site operator nor the second level reviewer is confident about the validity of data.

   Should unusually high data values be invalidated, the cause should be determined through investigations described in this section, and the data point(s) should be invalidated based on the discovered cause. **Reviewers must fully review all available information and use good judgement to determine that cause.** All the steps taken to arrive at this conclusion should be well documented and kept with the monthly data submittal package.

K. A minimum of 45 minutes of valid data within an hour are required to determine an hourly average.

L. For negative values less than the Minimum Detection Limit (MDL), the data should be flagged with appropriate QC/Op/Null codes. DMS details MDL

for each specific instrument on the instrument configuration screen of the Administration menu.

5.2 Zero, Precision, Span QC Check Data Review:

For zero, precision and span QC check data review, the automated QC checks and instrument diagnostic data are reviewed. Automated QC checks are typically conducted between 0350-0510 hours daily at full air monitoring stations and 0400-0500 for ozone-only stations. These checks are to identify the operational condition of monitors and to assure data quality. A QC check is performed by introducing a standard gas of known concentration (the "target value") into the sample stream of an air-monitoring instrument and recording the instruments response. By comparing the instruments response to the target value, a degree of accuracy (expressed as percent difference) for the instrument can be determined.

During this part of review, the first level reviewer needs to review all QC data to determine whether instrumentation issues will affect data. If issues are found from QC data that indicate instrument's problem, corrective action must be taken to edit or invalidate the data.

The reviewer should do the following:

A. Review the percent difference (using the 1-pt QC report) between the monitor's response value and the target value. When the percent difference for precision is less than the control limits of $\pm$ 7% (or $\pm$ 5% for ozone), and zero is within $\pm$ 3 ppb of zero (or $\pm$ 0.4 ppm for CO), a reviewer can assume that the monitor is operating properly and the ambient data bracketed by acceptable QC checks are all valid.

   If the percent difference exceeds the control limits of ($\pm$7.1% for ozone, $\pm$10.1 % for CO and SO2 or $\pm$15.1% for NO2), ambient data collected after that QC check may not be valid. The data reviewer should inform the site operator (if not the same person as the first level reviewer) and the second level data reviewer of the condition of instrumentation. The site operator and data reviewers should work together to determine the cause of issue (e.g. sample stream leaks, faulty analyzers, or faulty QC equipment, etc.). Faulty QC equipment will not invalidate the collected ambient data.

   When QC check results exceed the established control limits, the first level reviewer needs to initiate corrective action to identify and resolve the problem. Corrective action limits are designed around the data quality objective outlined in the U.S. EPA's CFRs.

If the control limit exceedance is the result of calculations and/or formulas not being applied correctly (i.e. temperature/pressure corrections, slope and intercept, etc.) and is verified independently by the calibration staff, post-processing of data may be utilized to reflect the correct concentrations. Refer to PQAO Quality Assurance Bulletin-006 "Post-Processing of Ambient Air Quality Data: released April 2016.

B. Review automated calibration results using the calibration control charts to verify data values are within the upper and lower control limits. The reviewer should print and submit these control charts as part of the monthly data submittal.

C. Review the latest true value entries for the responsible stations from the "True Value" screen in DMS to ensure they correspond to the latest QC instruments' calibration reports and the values are entered correctly using the date of calibration.

D. Review both the DMS graphical display of the analyzer's minute data and the instrument's monthly maintenance check sheet to establish QC data validity.

Like air monitoring instruments, QC systems may fail, yielding invalid QC results. For this reason, ambient data should not be invalidated based solely on QC data. Reviewers must check all other available information to determine if any data should be invalidated; follow the data validation guidelines in section 4 of this document.

5.3 Recordkeeping:

Recording complete and accurate notes are the important part of documentation. The site operator should document all analyzers performance, malfunctioning instruments, or indicated interferences. These notes should be documented on the monthly maintenance check sheets, station logbooks, and/or on DMS editor notes. At the end of the month, the data reviewer can refer to these notes for data validation.

After reviewing and validating data on DMS, the reviewer must show that all data have been reviewed by marking them as reviewed. For instruction on how to electronically mark data in DMS, please refer to the DMS SOP. First level reviewer need only to review the preliminary data but never to lock the data.

5.4 Monthly Data Submittal:

For each calendar month the first level reviewer needs to compile a monthly data submittal for each responsible site as part of the documentation requirement. The reviewer shall review the submittal package to ensure that it meets all the criteria outlined here.

The monthly data submittal should contain the following bold items at a minimum:

A. A copy of the **Calibration Control Chart** for each gaseous pollutant parameter operating at the site.

B. A copy of the **Monthly Quality Maintenance Check Sheet** for each operating instrument at the site.

C. A copy of the **Station Logbook** with pages covering the reported month only.

D. A copy of the **Data Capture Report** for all reportable parameters (i.e. all hourly gaseous, PM, and MET parameters) at the site. The data capture report can be generated from the DMS application. Please refer to section 5.12 of the DMS SOP.

E. A **DMS Invalid Data Summary Page** for each parameter operating at the site. The invalid data summary page provides a brief description why data by parameter was invalidated for a major portion of a day during the month.

F. Any information the first level data reviewer considers relevant to the overall data review process (i.e. calibration and audit reports, e-mails related to site operations, etc.).

Once completed, the first level reviewer should provide the monthly data submittal to the assigned second level data reviewer for further validation and review.

5.5 Data Package Submittal to Second Level Review:

Once the first level reviewer transmits or delivers data submittals to the second level reviewer, that data packet is considered to be in the custody of and becomes the responsibility of the second level reviewer. This is to preserve the independency for each level of data review. Therefore, should the first level data reviewer wish to make data changes after transfer to second level review,

the first level review shall coordinate with the second level reviewer. First level reviewer should not make changes to data without notice/coordination from the second level reviewer. Changes made shall be documented in the monthly data package.

6.0 SECOND LEVEL DATA REVIEW

The second level data review is a macroscopic review focusing on review of first level reviewer, diurnal and seasonal trends surrounding high/low values, exceedances, QC requirements and data, and like instruments comparison. The reviewer should determine if first level reviewed data are reasonable or not, and to determine if additional edits are needed.

One important aspect for second level data review is to ensure that data verification practices were performed.

Second level reviewer should view QC data daily, if possible, and weekly at a minimum. If encountering an issue, the second level reviewer should contact the first level reviewer and notify him/her that the QC data indicates a problem exists. They should inquire whether the problem was identified and repaired. Any corrective action taken must be documented in the station logbook, monthly maintenance check sheet, and the DMS's editor notes. Follow up by reviewing the Monthly Calibration Control Chart webpage to confirm that the corrections were incorporated into DMS.

Finally, the second level reviewer should summarize any abnormal data findings or disruption from each assigned site, and put together the monthly data report from each site to form a complete monthly data package for the third level data review.

6.1 Monthly Max/Min and Exceedances:

Note: For instruction on how to generate a Monthly Exceedance Report on DMS, please refer to Section 5.10 of the DMS SOP.

Based upon the results of the Monthly Exceedance Report, the second level reviewer should assess the quality of each exceedance based on diurnal and seasonal trends, QC data, first level data edits, monthly maintenance worksheets, and logbook entries. If the reviewer finds a reason that may compromise the validity of the data, then the reviewer should make the necessary edits to the data.

The list of questions below will aid for determining the validity of the data.

- Are these values typical for the time of year?
- Is the diurnal profile reasonable?
- Is the hour of the daily max value typical?
- Do the values trend up to a max or down to a min?

- Is the day complete? Are the reasons for missing data noted?
- Are the daily max/min values impacted by a source or unusual condition?
- Are the sources or unusual conditions noted?

1. Determine if the maximum values are greater than or equal to the level of the State/Federal Ambient Air Quality Standard.

2. Determine if the range between the min and max are reasonable.

3. Unusually high values may be invalidated if the criteria outlined in Section 5.2 of this document are met.

The second level reviewer should inform the first level reviewer of any significant data edits.

6.2 QC/Op/Null/Qualifier Codes Check:

Second level reviewer should check all questionable data in DMS to see if any QC, Op, and/or Null/Qualifier codes are missing or additionally required.

- Ensure all QC checks are appropriately flagged.
- Ensure all power outages and data gaps are flagged.
- Ensure all equipment failures are appropriately flagged.
- Ensure the QC, Op, and Null codes match the comments on the monthly check sheet, station logbooks, and editor notes on DMS.
- Ensure the QC, Op, and Null codes adequately detail the situation.

6.3 Instrument Operational Parameters Check:

Second level reviewers should review all Monthly Maintenance Check Sheets to ensure each instrument operational parameters are within the established criteria.

Verify the site's indoor temperatures are within a range of 20 to 30 °C, or in the proper operational temperature range specified in the appropriate SOP of the samplers and analyzers.

Note: Do not invalidate the temperature data. Only invalidate the questionable pollutant data during the time those instrument operational parameters or indoor temperature have fallen out of range. Apply appropriate QC/Op/Null codes to the data.

6.4 Same Site Parameters Comparison:

When in doubt about certain data trends or spikes, second level reviewers should perform a same site parameters comparison to verify if their conjectures are real or not.

1. Compare the CO, NO, NO2 and NOx concentrations as these parameters tend to track with each other. For example, CO and NO parameters usually increase and decrease together.

2. Ensure the sum of NO2 and NO concentrations are equal to or less than the NOx's and the NO values are always less than the NOx values.

3. Ensure that high concentrations of NO and O3 do not occur at the same time, since NO reacts to O3 to form O2 and NO2.

4. For sites operating continuous PM2.5 and PM10 monitors, ensure that PM10 values are higher than the PM2.5, since PM2.5 is a subgroup of the PM10 particles.

5. Compare collocated data, if available. The collocated data should track and compare well.

6. Check the meteorological parameters to ensure the wind speed (RWS) and wind direction (RWD) values change from time-to-time, and the outside temperature (OT) and relative humidity (RH) for the ambience follow diurnal patterns.

6.5 Buddy Sites Comparison:

If a same site parameters comparison does not provide any clues to the issue, the data reviewer can perform a buddy sites comparison, which will compare like parameters between sites within proximity of each other and/or in the same air basin, to help detecting any instrument problems.

However, this must be done with caution and should not be the final determining factor in data validation. Always try to evaluate all other relevant information sources, and to reach consensus with the first level reviewer on any differences found in the comparison review.

6.6 Data Review and Lock Check:

Note: The actual steps for marking and locking reviewed data on DMS will not be covered in here. For details, please refer to Section 5.5 of the DMS SOP.

One of the tasks for the second level reviewer is to verify that DMS data, that are subject to submittal to AQS, are fully reviewed, and then to lock them for submission. By locking the data, they are certified against tampering without traces.

Data reviewers are required to lock only the hourly data. Minute data do not needed to be locked but be checked to have been reviewed by first level reviewer. Data that are not locked in DMS can be purged by the system after expiring from the data retention requirement.

In DMS, reviewed data records are indicated with an "R" at the beginning of the data records in the data table, while locked records are indicated with an "L" in the same area of the data table. Should the need to re-edit data arises, data can be unlocked following a similar approach for data locking.

6.7 Data Package Submittal to Management:

The second level reviewers should provide a summary sheet as a cover page for the data package they have reviewed. This summary sheet should highlight and describe in sufficient detail any significant issues observed for reviewed sites during the reporting month. For example, BAM zero test results, instrument calibrations, major maintenance or repairs, and any other interruptions of data that are 24 consecutive hours or more, should be noted. When documenting data interruptions on the summary sheet, include the start dates and times, hours affected, and the reason for the interruptions.

After all DMS data are reviewed and locked, second level reviewers can complete reviewing the hardcopy monthly data package and then forward the package to the third level reviewer. The second level reviewers must initial and date every page of each document in the monthly data submittal package signifying the whole document has been reviewed, and all data quality checks were performed.

7.0 THIRD LEVEL DATA REVIEW

Third level data review is performed by management. After section managers receive all the monthly data packages from the second level reviewers, there are several tasks for the section managers to complete before handing the assembled data packages to the Branch Chief for final approval to release.

7.1 Section Manager Review:

Section managers shall review the monthly data submittal package to ensure that data are complete, stations were maintained properly, and instruments were operating within acceptable criteria for the reported month.

1. Section managers will assemble monthly data submittal packets for the Branch Chief under an initialed cover memo. The cover memo should summarize the findings of first and second level data reviewers.

2. Section managers should ensure that all quality control and data quality activities were performed diligently by their staff. Any issues should promptly address with the appropriate staff.

3. Section managers should review any active Corrective Action Notification (CAN) and Air Quality Data Action (AQDA) requests for their sections to ensure progress is being made on those issues.

7.2 Branch Chief Review:

The Branch Chief should review monthly data submittal packages and attached documentation and initial cover memos signifying approval of the data release to AQS. The Branch Chief should forward the approved data packages to the ODSS manager for logging and release for AQS submittal. The Branch Chief should also provide copies of the initialed cover memos to section managers to inform them that the data are approved for AQS. upload.

Branch Chief review should consist of high-level checks for completeness and consistency. For example, review the network exceedance and data completion reports for the overall network health and status. Any issues should be discussed promptly with the appropriate section manager.

Periodically the Branch Chief should review all annual management site review reports (as specified in section 9.3 of this SOP), all the active Corrective Action Notifications (CAN) and Air Quality Data Action (AQDA) requests, for any potential problems.

8.0 DATA CORRECTION

The implementation of a comprehensive corrective action system is an essential component for maintaining data quality and facilitating continuous process improvement.

During the data collection and review process, issues may be uncovered that could affect data quality. When problems are identified, corrective action must be taken to resolve the issues. Depending on the data status (whether have been submitted to AQS or not), there are different ways to handle the data correction request.

In this section, the data correction process and the tools used for data correction will be covered. These tools are the Data Correction Memo, the Corrective Action Notification (CAN), and the Air Quality Data Action (AQDA) request.

8.1 Pre/Post AQS Submission:

Before data are uploaded to AQS, data reviewers from any level can authorize corrections to the data in DMS during any stage of the data review process, as long as the data edits have been fully justified and documented in the DMS's editor notes and/or the monthly data submittal package.

If a data submittal package has been submitted to ODSS but the data are not yet uploaded to AQS, management can request a hold to the data submittal process by contacting the ODSS manager or the ODSS staff with regard to the correction.

Once data are submitted to AQS, the section managers and the branch chief must provide a formal request (i.e. a data correction memo with a CAN or AQDA) on the data issue in order to initiate and authorize the data correction, with ODSS staff performing the actual correction in AQS.

8.2 Data Correction Memo:

A Data Correction Memo is typically used in conjunction with an AQDA or a CAN, however, it can also be used as a stand-alone data correction request within AQSB internally. The memo acts as a cover letter that documents the findings of the AQDA or CAN and specifies how the data on AQS is to be corrected.

The Data Correction Memo should include:

- Action requested.
- Detailed reason for requested action.
- Site information (Site name and ID).
- Parameter affected by request (including parameter/method codes, POC numbers, instrument property numbers).
- Timeframe affected and sampling duration.
- The corresponding AQDA or CAN attachment (if available).

The Data Correction Memo, along with the attached AQDA or CAN request, should be sent to the Branch Chief for review through the section manager, with the ODSS manager courtesy copied. Upon approval, the ODSS manager will direct staff to carry out the request.

AQSB staff can submit a Data Correction Memo without the AQDA or CAN when the request is initiated internally within AQSB and the scope of the correction is focused. AQSB should initiate a CAN, in lieu of a stand-alone Data Correction Memo, when the findings may affect other site operators or can affect instruments network wide.

8.3 AQDA and CAN:

An ADQA is a request for an investigation of the validity of ambient air quality data generated by CARB's Quality Assurance Section (QAS). Upon review of audit results that show air monitoring equipment operating outside CARB's control limits or federal requirements, the QAS will initiate an AQDA.

In addition to the ADQA process, CARB uses another corrective action process referred to as the CAN process. The CAN process documents issues that would impact, or potentially impact, data quality, completeness, storage, or reporting.

Any person working within the CARB PQAO can initiate a CAN. The goal of the CAN process is to investigate, correct, and reduce the recurrence of these issues. As such, the CAN process will identify issues not addressed by AQDAs, improves data quality, and helps ensure compliance with state, federal, and local requirements.

For details of the AQDA or CAN process established by the Quality Management Branch (QMB), please visit this webpage, Corrective Action Notification (CAN).

The following figures are samples of the AQDA request (figure 8.1) and the CAN request (figure 8.2).

Air Quality Data Action Request

SITE NAME: Paso Robles **REQUEST LOG #:** 8406
SITE NUMBER: 40650 **AQS#:** 060790005 **POC#:** 2 **REQUEST DATE:** 05-23-2018
TO: David Cardiel, Air Monitoring/APCD. Please investigate the potential inaccuracies listed below and recommend appropriate action(s). If no response is received by 07-07-2018, QA staff shall review and recommend appropriate action(s), which may/may not affect the data involved.
TO: Sunghoon Yoon, Air Quality Data Review. Please withhold the following air quality data from processing until potential data inaccuracies are resolved.
FROM: Aaron Plasencia, Quality Assurance Section.

POLLUTANT	EST. TIME PERIOD *			REASON FOR ACTION
BAM	From:			During the performance audit conducted on May 9, 2018 the BAM PM10 (Serial # M8036) failed a critical criteria as found in the U.S. EPA QA Handbook Volume II Appendix D, dated March 2017. Specifically, the one point flow rate verification for the month of March 2018 was missing. The analyzer was last calibrated November 15, 2017.
	11	15	2017	
QUALIFIER CODE	Month	Day	Year	
	To:			
	06	29	2018	
	Month	Day	Year	

Air Monitoring/APCD completes the following block based on their quality control records, signs and returns the form to the Quality Assurance Section. * Exact interval to be determined by district.

RECOMMENDED DATA ACTION		TIME PERIOD (INCLUSIVE)					‡CORRECTION FACTOR
RELEASE:		BEGIN:		00	00	0000	
CORRECT‡:		END:		00	00	0000	*NULL CODE
INVALIDATE*:			Hour	Month	Day	Year	
FLAG DATA*:							

Justification/Corrective Action Taken

Reviewed By:
1. Aaron Plasencia Date: 05/23/2018
2. [signature] Date: 5-23-18
3. _____ Date: _____
4. _____ Date: _____

The recommended data actions were applied and the air quality data were updated on the AQS/ADAM Database by _____ on _____

California Air Resources Board MLD-40 (Revised 7/13/xx)

Figure 8.1: Sample Air Quality Data Action Request

Corrective Action Notification

CALIFORNIA AIR RESOURCES BOARD

This form is used to document issues that may impact or potentially impact data quality, completeness, storage, or reporting.

Section I: (to be completed by initiator) **Initiator:** Matthew Densberger

Issued to: **Date:** 01-18-2019

Subject: AQS Flags for Exceptional Events **Agency:** California Air Resources Board

Reason for Corrective Action Notification (continue on an attachment if needed):
Sutter Buttes, 06-101-0004-44201-1 - Add "IT" and event description as shown in attached table.

Start Date/Time: **End Date/Time:** **Estimated?** N

Parameter(s) affected: ozone **Expected Completion Date:** 03-10-2019
*Up to 45 days from Initiation Date

Supervisor: Jin Xu **Date:** 01-18-2019

Section II: (to be completed by responsible section or organization)

Corrective Action Taken (continue on an attachment if needed):
FRAQMD requests the flagging of data for Sutter Buttes (06-101-0004) as specified in the attached table. These data were potentially influenced by exceptional events and the request to flag the data with the REQEXC code IT - Wildfire-U.S. is appropriate. Start End Date Concentration Units Hour Hour Requested Flag 7/28/2018 0.08 ppm 14 23 IT 7/29/2018 0.08 ppm 0 6 IT 7/29/2018 0.075 ppm 13 23 IT 7/30/2018 0.075 ppm 0 1 IT 7/30/2018 0.083 ppm 14 23 IT 7/31/2018 0.083 ppm 0 6 IT 7/31/2018 0.085 ppm 12 23 IT 8/1/2018 0.085 ppm 0 1 IT 8/1/2018 0.085 ppm 12 23 IT 8/2/2018 0.085 ppm 0 0 IT 8/2/2018 0.071 ppm 13 21 IT 8/7/2018 0.075 ppm 15 23 IT 8/8/2018 0.075 ppm 0 1 IT 8/9/2018 0.079 ppm 11 23 IT 8/10/2018 0.079 ppm 0 0 IT 8/10/2018 0.077 ppm 11 22 IT

Action taken by: Matthew Densberger **Date:** 01-18-2019

Resolution (continue on an attachment if needed): *Include changes to prevent recurrence, and any effect on data.
The request to flag data has been completed. The Ozone data was flagged for exceptional events with the qualifier code IT- Wildfire- U.S. for the time period requested 07/28/2018- 07/31/2018, 08/01/2018- 08/02/2018, 08/07/2018- 08/10/2018. See attached the AMP350 report.
Note : An event description couldn't be added on the event description field on AQS as requested, due to this field is protected against update, although the event description was added on the comments field on AQS.

Resolved by: Maria Escobar **Date:** 02/20/2019

Forward to: Michael Miguel, PQAO Point of Contact; PO Box 2815, Sacramento, California 95812; michael.miguel@arb.ca.gov
For questions regarding the CAN process, contact: PQAO@arb.ca.gov **CAN # assigned:** 390

California Air Resources Board MLD/QMS-064 (new)

Figure 8.2: Sample Corrective Action Notification

9.0 DATA QUALITY ACTIVITES

This section outlines the quality control activities performed by AQSB staff for assuring the quality of data generated by CARB.

9.1 Weekly Status Report:

AQSB staff with station operation responsibilities are expected to report the weekly status of monitoring operations to their section manager each week.

AQSB staff should follow and/or perform the activities below for the weekly status report:

Site Operators

1. The site operators should perform the following and report to their section manager by noon of each Friday or the last workday of the week.

    - Include the status of all operational and non-operational equipment.
    - Include plans to bring non-operational equipment back online.
    - Note reason for any missed/invalid samples and the planned date for a make-up.
    - Note any disruption in sample shipping that may have compromised the validity of the samples (for instance, samples shipped late, etc.).

2. Check the automated calibration results for assigned sites each day.

3. For part requests, alert section manager if the parts needed are not available or not expected to be available within three working days. Proactively follow-up on the requests with the section manager and the shop/warehouse staff.

4. For instrumentation issues, alert section manager if instruments are not available or not expected to be available within three working days.

5. Return repairable parts and serviceable equipment to the warehouse/shop promptly.

6. Proactively follow-up on non-operational equipment until it is back from the warehouse/shop and is operational again.

Site Secondary Staff

1. Act as QC Officer for all equipment at assigned sites and report to the section manager of any issue that may compromise data/sample quality or completeness.

2. On a weekly basis, check the nightly calibration results for assigned sites, and recommend specific action to site operator as needed to correct the issue observed.

3. Periodically check (at least twice a year) that equipment maintenance is completed as required per SOPs, monthly check sheets, and technical bulletins, etc. For instance, verify sampler probe has been cleaned/replaced per recommended schedule. Report any deficiencies to site operator and section manager.

4. Check the station logbook to ensure that it is being maintained properly. Make recommendation to site operator if any problem is found.

5. Periodically review the Monthly Quality Control Check Sheets; verify operating parameters of the instruments. In particular, check the instrument flows, and for the ozone analyzer check the lamp intensities. If a sampler is close to being out-of-spec, recommend specific action to the site operator.

6. Verify that the precision gas cylinder certification dates and pressure are within specifications.

Instrument Shop/Warehouse Staff

1. Notify the shop/warehouse supervisor when spare instruments are not available. For example, when shipping the last serviceable unit out, inform the supervisor of the last availability.

2. Promptly address parts requests and ship-to-field ‘next day’ delivery requests made by field staff. If in question, contact the requester for verification.

3. Provide constructive feedback to field staff when equipment failure cannot be duplicated in the shop and/or if failure was likely preventable.

4. Track and verify that the non-operational equipment and repairable parts have returned from the field.

Section Managers

1. Report the section network status and any newfound issues (if available) to the Branch Chief by 3pm before the end of Friday each week.

2. Follow-up with staff regarding part requests or reported instrumentation issues to ensure those requests/problems are resolved in a timely manner.

9.2 Air Monitoring Site Information Report:

Air monitoring site information shall be documented in the form of a site report. The purpose of a site report is to ensure that the most accurate and current information relating to an air monitoring site within the network is documented and updated on AQS.

For each air monitoring site in our network, a site report should be submitted to the appropriate air monitoring section manager by the site operator and/or the site secondary staff. Once reviewed by management, the site report should be forwarded and maintained by the data support team. ODSS staff would update AQS with any changes to the continuous monitoring network.

Responsibilities

Air monitoring section managers are responsible for confirming accurate site information is maintained for each monitoring site in their section.

Site operators and site secondary staff should meet and review the site report annually for accuracy. **The site operator should maintain a copy of the most recent site report in a binder located at the site.**

ODSS should keep a copy of the site reports and update AQS with any changes applicable to the CARB monitoring sites for the continuous network.

Requirements

A complete site report should consist of the following five forms, as shown in Appendices C of this document. The report may contain several MLD-5 and MLD-6 forms, if a site has multiple pollutant parameters.

- Supervisor Site Visit Check Sheet
- Site Identification Report (MLD-4)
- Probe/Sampler Identification Report (MLD-5)

- Pollutant/Project Identification Report (MLD-6)
- Site Initiation/Termination Report

9.3 Annual Management Site Visit:

Section managers or a designee should perform site visits to all air monitoring sites in their section on an annual basis. This visit is to assess safety, housekeeping and operations at each monitoring station. Use the Supervisor Site Visit Check Sheet, outlined in Appendix C1, to document all site details and any findings during visits.

Any discrepancies found should be discussed with the site operator or relevant staff. Section managers should follow up with site operators to ensure all discrepancies are addressed in a timely manner.

Section managers should retain the completed site visit check sheets until their next site visit in order to track discrepancies that need addressing over an extended period of time.

9.4 Field Documentation:

Field documentation is a critical and important aspect of air monitoring station operations. Since the site operator is most likely the only person with knowledge of the day to day operations in the field, detailed documentation of the data collection process will allow all level of data reviewers to quickly resolve data issues should they arise..

Field documentation typically includes documenting maintenance, operational checks, calibrations, and all other activities that may affect data quality. The requirements below should be followed to ensure there is adequate amount of documentation for all air monitoring activities that take place both inside and outside of the station, as to provide full defensibility to the data collected.

General Documentation Procedures:

1. Keep the required documentation in a safe place in the station where it can be easily found.

2. Make every entry legibly in pen; use of pencil is not allowed.

3. Do not erase, write over, or whiteout an entry. To delete an entry, draw a single line through the error so the entry is still legible. Then make corrections next to deleted entries if possible. Always initial and date the corrections when they are made.

4. Make entries clear, concise and easily understandable. Each entry should be complete enough for other qualified staff to read and comprehend.
5. Make entries regularly in the station logbooks and check sheets when work is performed. Ensure that the documentation is up to date at the end of each workday or site visit.

Station Logbook:

1. A monitoring station logbook must be maintained at each monitoring site. Any conditions that may influence the data must be recorded in the logbook. Some examples are: nearby construction, abnormal traffic patterns, unusual noises, vibrations, and unusual weather.

2. Fully label the front and inside covers of the station logbook with the Site Name, Site ID, Start and End Dates. Store all completed logbooks onsite for future reference. Each page of the logbook should have identification with the site name or ID as well.

3. Record who performed the work performed at the station and the date the work was done. All entries should be signed or initialed.

4. Calibration results shall be recorded into the station logbook and should include the following: correction slopes and intercepts, transfer standards used, property numbers and or serial numbers and certification dates.

5. All persons entering a monitoring station must sign into the station logbook and indicate the date, name, and their affiliation.

6. Equipment installed into or removed from a station should be listed in the station logbook. Entries are to include the make, model, serial number and property number of the instrumentation and the reason for installation or removal.

7. Entries to the station logbook should include maintenance, repairs, calibrations, relocations and other pertinent information. These entries should also include all things such as, sample inlet particulate filter replacement, sample flow rate adjustments, zero adjustments, capillary cleaning and adjustments, leak checks, lamp replacements, lamp adjustments, performance check results or alterations to the sampling train.

8. Do not tear page(s) out of the logbook.

9.5 Zero Air Qualification:

For ambient air monitoring activities, zero concentrations can be acquired through zero air generation devices. Currently CARB uses the following zero air sources.

- Station zero air generators
- Portable zero air scrubbers
- Certified ultrapure cylinders

U.S. EPA guidance states that zero air sources, utilized for calibration of air monitor instrumentation, must be treated as a standard. Although zero sources are not required to be traceable to a primary standard, care should be exercised to ensure that zero sources (generators or scrubbers) used are adequately free of all substances likely to cause a detectable response from the analyzer and, at a minimum, below the lower detectable limit of the criteria pollutants being measured

Zero air qualification is a QC process used to document the quality of zero air sources which are used for calibration of ambient air monitors. Qualification includes the documentation of zero air source maintenance and verification against a separate zero air source.

CARB utilizes station zero air generators as a source of zero and dilution air to create desired gas standard concentrations for the gaseous monitors in the network during automated zero, precision and span QC checks. This is a common practice and will continue to be acceptable.

In addition, CARB performs multi-point verifications/calibrations at specific intervals and when required (new/replacement equipment is installed, after major maintenance etc.) Qualified zero air used for these events is generated by the use of portable air scrubbers and/or ultrapure zero air cylinders. **The use of the station zero air generators is not permitted for air monitoring instrument verifications/calibrations.**

To document the verification of portable zero air sources, CARB has implemented a process where instrument response from the comparison of a portable zero air scrubber is compared to zero air from an ultrapure zero air cylinder. When performing this verification, the portable zero air scrubber must be within +/- 3.0 ppb (for O3/NO/NOx/SO_2) and +/- 0.020 ppm (for CO/THC) of the ultrapure cylinder specification (e.g. Scott-Marrin Ultrapure Air; O3/NO/NOx/SO_2 <0.001 ppm, CO/THC <0.01ppm). This verification criteria was developed by CARB's Air Quality Surveillance Branch and approved by U.S.

EPA Region IX as a corrective action to a 2011 technical system audit finding related to documenting the quality of zero air being used in the air monitoring program.

Ultrapure air cylinder and portable air scrubber comparability **must be documented**. The documentation should include the ultrapure cylinder number and certification date, the portable air scrubber barcode and serial number, and the analyzer's response to each zero source.

In the event that the analyzer's response to the portable air scrubber varies by more than 3.0 ppb (for O3/NO/NOx/SO2) or more than 0.020 ppm (for CO/THC), another portable air scrubber meeting the criteria or an ultrapure air cylinder must be used. Ultrapure zero cylinders used for comparison may be stored at the air monitoring station or transported to field locations.

To document maintenance requirements of zero air sources, maintenance checks on ALL zero air sources should be recorded to ensure that they are still operating within design parameters and supplying clean zero air.

9.6 Quarterly AQS Data Review and Annual Data Certification:

CARB recommends that MO's review regulatory data submitted to AQS on a quarterly basis. The quarterly review consists of reviewing AQS AMP reports: These reports include, but not limited to,

- AMP 256 – Data Quality Indicator Report
- AMP 350 – Raw Data Report
- AMP 360 – Raw Data Qualifier Report
- AMP 390 – Monitor Description Report
- AMP 430 – Data Completeness Report

On a quarterly basis, CARB's ODSS inspects and reviews CARB data uploaded data to AQS to ensure the completeness of submission.

On an annual basis, CARB's AQSB reviews the AQS AMP 600 (Certification Evaluation Report) for CARB data collected within CARBs ambient air monitoring network. Once all outstanding data issues have been addressed, the AQSB Branch Chief submits a data certification letter to CARB's Air Quality Planning and Science Division (AQPSD) effectively certifying continuous data collected within CARB's air monitoring network.

Data certification is required by U.S. EPA regulation. The process ensures that data are correct and have been validated to the best knowledge of the MO. It

ensures data quality integrity and defensibility so that CARB and U.S. EPA can safely use the data in regulatory actions.

CARB's AQPSD is responsible for submitting a data certification package to the U.S. EPA Region IX Office that covers the data reported to AQS by CARB and CARB PQAO Districts.

The data certification package includes:

- The CARB certification letter
- Letters supporting data certification from other monitoring agencies
- All required AQS reports

APPENDIX A1
AQSB Data Review Schedule (CY2019 Schedule)

2019 Data Review Schedule [1]

MLD- ODSS. Revised 12/06/18 T.E

End of reporting period	Data due to 2nd Level review	Data due to Manager for review	Data due to Brand Chief for review	Data due to MLD- ODSS	Data in AQS
	15 days	35 days	45 days	50 days	60 days
Dec 2018	01/15/19	02/04/19	02/14/19	02/19/19	03/01/19
Jan 2019	02/15/19	03/07/19	03/17/19	03/22/19	04/01/19
Feb 2019	03/15/19	04/04/19	04/14/19	04/19/19	04/29/19
Mar 2019	04/15/19	05/05/19	05/15/19	05/20/19	05/30/19
Apr 2019	05/15/19	06/04/19	06/14/19	06/19/19	06/29/19
May 2019	06/15/19	07/05/19	07/15/19	07/20/19	07/30/19
Jun 2019	07/15/19	08/04/19	08/14/19	08/19/19	08/29/19
Jul 2019	08/15/19	09/04/19	09/14/19	09/19/19	09/29/19
Aug 2019	09/15/19	10/05/19	10/15/19	10/20/19	10/30/19
Sep 2019	10/15/19	11/04/19	11/14/19	11/19/19	11/29/19
Oct 2019	11/15/19	12/05/19	12/15/19	12/20/19	12/30/20
Nov 2019	12/15/19	01/04/20	01/14/20	01/19/20	01/29/20
Dec 2019	01/15/20	02/04/20	02/14/20	02/19/20	02/29/20

[1] These dates may vary slightly from the calculated due dates because of weekends and holidays.

* This is a sample schedule for 2019. Current schedule is available on the DMS homepage.

APPENDIX B1
LIST OF QC CODES

QC Code	Description	Default Coding
0	Valid Data	None
1	Adjusted	None
2	Averaged	None
3	Interpolated	None
4	Suspect (Flow Rate)	* Reviewer's Discretion
5	Suspect	* Reviewer's Discretion
6	Suspect (Audit)	* Reviewer's Discretion
7	Insufficient Data	Null Code (AI)
8	Missing	Null Code (AI)
9	Invalid	Null Code (AI)
10	Auto Calibration	Null Code (BD)
11	Manual Calibration	Null Code (AT)
12	Precision Check	Null Code (AX)
13	Zero/Span Check	Null Code (AY)
14	QA Audit	Null Code (BL)
15	Poor QA Results	Null Code (AS)
20	Voided by Operator	Null Code (AL)
21	Misc. Void	Null Code (AM)
22	Maintenance/Routine Repairs	Null Code (BA)
23	Unable to Reach Site	Null Code (BB)
24	Operator Error	Null Code (BJ)
25	Missing O3 not likely to exceed	Null Code (BG)
30	Construction/Repair in Area	Null Code (AC)
31	Vandalism	Null Code (AP)
32	Shelter Temp Out of Limits	Null Code (AE)
33	Building/Site Repair	Null Code (BE)
40	Sample Flow Out of Limits	Null Code (AH)
41	Machine Malfunction	Null Code (AN)
42	Site Computer/Logger Down	Null Code (BK)
43	Value Below MDL	Null Code (BR)
44	Power Failure	Null Code (AV)
45	Detection Limit Analysis	Null Code (DL)
46	Low Sample Volume	Null Code (SV)
47	Instrument Over Range	Null Code (BN)
99	Test data	Null Code (XX)

* Refer to the full list of U.S. EPA Qualifiers on the EPA website at: US EPA AQS Code List

APPENDIX B2
LIST OF OP CODES

Op Code	Description	Mapped QC Code
0	Valid data	0
1	Zero	0
2	Gas Precision	0
3	Gas Midpoint	0
4	Gas Span	0
5	Recovery	10
7	Insufficient Data	7
9	Invalid data	9
11	Gas Zero (2)	0
12	Gas Precision (2)	0
13	GPT Midpoint	0
14	Gas Span (2)	0
15	Span GPT	0
21	Gas Zero (3)	0
22	Gas Precision (3)	0
23	Ozone Midpoint	0
24	Gas Span (3)	0
31	Gas Zero (4)	0
32	Gas Precision (4)	0
34	Gas Span (4)	0
40	Instrument Malfunction	41
41	Instrument Flow Error	41
42	Instrument Pressure Error	41
43	Instrument Temperature Error	41
50	Power Failure	44
51	Maintenance	22
52	Instrument Repair	22
53	Off-line	20
54	Bad Condition – Valid	0
55	Bad Condition – Invalid	9
56	Positive Over Range – Valid	0
57	Positive Over Range – Invalid	9
58	Negative Under Range – Valid	0
59	Negative Under Range – Invalid	9
60	QA Audit	14
61	Rate of Change	9
62	QC Check	0

Op Code	Description	Mapped QC Code
63	MDL Check	9
64	BAM Zero Test	13
65	Autocal – off phase	10
66	O3 Gen Cal (IZS)	10
67	TCO Auto Zero	10
68	Calibration	11
69	Autocal	10
99	Test Data	99
255	Any Op Code	0

APPENDIX B3
COMMON QC/OP/NULL CODE COMBO

QC Code	Op Code	Null Code	Description
0	0	-	Valid Data
0	1	-	Automated QC check, valid zero data
0	2	-	Automated QC check, valid precision data
0	4	-	Automated QC check, valid span data
7	7	AI	Insufficient data
10	63	DL	MDL check
10	67	BD	Trace CO auto zero check, invalid data
10	69	BD	Automated QC check, invalid data
11	68	AT	Semiannual multi-point calibration
12	62	AZ	BAM bi-monthly flow check or QC check
13	51	BA	Instrument maintenance (Zero/Span check)
13	62	AY	Gaseous instrument zero-filter check
13	64	AY	BAM zero-filter check
14	60	BL	QA audit
20	53	AL	Voided by operator
21	53	AM	Instrument offline (Misc. void)
22	51	BA	Instrument maintenance (General)
33	53	BE	Instrument offline (Site repair)
41	40	AN	Instrument malfunction
43	59	BR	Value less than negative MDL
44	50	AV	Instrument power fail

APPENDIX C1
Supervisor Site Visit Check Sheet

Site:_____ Date:_____

Supervisor:_____ Station Operator:_____

Station Items to Review:		Yes	No	COMMENT
Does wind direction reading seem accurate?				
Does wind speed reading seem accurate?				
Is site secure? Are all equipment secured to prevent theft? Are ladders locked and climbing restrictions in place?				
Is site exterior clean? (no vandalism or graffiti)				
Are site safety features up to date? Fire extinguishers? Safety rails intact and appropriate? CO detector?				
Is site interior clean and orderly?				
Is site temperature 20 to 30°C				
CARBLogger	Time and date correct?			
	Channel scan ok? Are channels displayed in Red?			
	Data downloaded on schedule?			
Log book (current)	Are entries current, complete, and initialed?			
Log book (historical)	Present?			
Are monthly check sheets current and complete?				
Are nightly auto-calibration records current?				
Is most recent semiannual multipoint calibration available at site?				
Is sample manifold clean?				
Is sample tubing clean?				
Is date recorded in logbook when sample manifold and tubing last cleaned?				
Instrument fault lights OFF?				
Any instrument down? Why?				
Cylinders	Expiration date (> 3 months)?			
	Is pressure > 500 psi?			
Monthly PM-10 flow check performed?				
PM-10 flow check within spec (+/- 7%)?				
BAM bi-weekly flow check and leak check performed?				
BAM flow and leak check within spec (+/- 4%, < 1.0 LPM)?				
Sample residence time calculated? Is < 20 seconds? Is calculation in logbook or posted?				

APPENDIX C2
Site Identification Report (MLD-4)

DATE: _____

Site Identification Report

California Air Resources Board
Monitoring and Laboratory Division
Air Quality Surveillance Branch

ATTACH AN 8 ½" X 11" PORTION OF A U.S. GEOLOGICAL SURVEY (OR LOCAL STREET) MAP INDICATING SITE LOCATION.
INCLUDE PHOTOGRAPHS OF THE FOUR QUADRANTS SURROUNDING THE SITE

REPORT COMPLETED BY: ☐ NEW SITE ☐ AMENDS A PREVIOUS REPORT

TO BE COMPLETED BY REPORTING AGENCY

AQS SITE IDENTIFICATION NUMBER: STATE CODE | COUNTY CODE | SITE ID

AGENCY RESPONSIBLE FOR SITE

SITE LOCATION (AIR BASIN) COUNTY

GEOGRAPHICAL COORDINATES (ENTER LATITUDE & LONGITUDE OR UTM COORDINATES)

DECIMAL LONGITUDE: - . DECIMAL LATITUDE: + .

OR

UTM ZONE | EASTING COORDINATES (METERS) | NORTHING COORDINATES (METERS)

CHECK ONE ITEM IN EACH CATEGORY THAT PERTAINS TO THE SAMPLING SITE:

LOCATION SETTING

☐ 1. URBAN AND CENTER CITY ☐ 2. SUBURBAN ☐ 3. RURAL

LAND USE TYPE

☐ 1. INDUSTRIAL ☐ 2. RESIDENTIAL ☐ 3. COMMERCIAL ☐ 4. FOREST ☐ 5. DESERT ☐ 6. MIXED ☐ 7. BLIGHTED AREA ☐ 8. MILITARY RESERVATION
☐ 9. AGRICULTURAL ☐ 10. OTHER (SPECIFY IN COMMENTS)

PROJECT TYPES

☐ 1. POPULATION-ORIENTED SURVEILLANCE ☐ 2. SOURCE-ORIENTED AMBIENT SURVEILLANCE ☐ 3. BACKGROUND SURVEILLANCE ☐ 4. COMPLAINT INVESTIGATION ☐ 5. SPECIAL STUDIES
☐ 6. EPISODE MONITORING ☐ 7. GLOBAL SURVEILLANCE ☐ 8. DUPLICATE SAMPLING ☐ 9. CONTINUOUS AIR MONITORING PROGRAM ☐ 10. EXPOSURE STUDIES

EST. TRAFFIC VOLUME ON NEAREST STREET (VEH./DAY) EST. CITY POPULATION

IS THE AREA WHERE AIR MONITORING INSTRUMENTS ARE LOCATED TEMPERATURE CONTROLLED AT 25° C ± 5° C? ☐ 1. YES ☐ 2. NO

ELEVATION OF SITE (INSTRUMENTS) ABOVE GROUND (METERS) ELEVATION OF GROUND ABOVE MEAN SEA LEVEL (METERS)

SITE ADDRESS: NUMBER STREET

CITY STATE ZIP CODE

COMMENTS (ENTER COMMENTS THAT WILL HELP IDENTIFY THE SITE SUCH AT LANDMARKS, TERRAIN FEATURES, ETC.)

ARB APPROVAL (INITIALS, DATE)

AIR QUALITY MONITORING: QA: AIR QUALITY DATA:

MLD-4 (Revised 3/31/97)

APPENDIX C3
Probe/Sampler Identification Report (MLD-5)

CALIFORNIA AIR RESOURCES BOARD
MONITORING AND LABORATORY DIVISION
AIR QUALITY SURVEILLANCE BRANCH

PROBE/SAMPLER IDENTIFICATION REPORT

This report is to be completed when installing or relocating any probe or individual sampler at the site identified below. Attach a dimensioned schematic drawing (A) The configuration of each probe and distribution manifold; (B) The location of each individual sampler in respect to other samplers and (C) Any obstructions which meet the criteria presented below. Identify on the schematic the pollutants sampled from each probe or sampler.

This Report : ☐ Is for a New or Relocated Probe or Sampler ☐ Amends a previous report

STATE CODE | COUNTY CODE | SITE ID

Report Completed by: Date :

Site Name :

Site Address (Number, Street, City) :

Site Location (Air Basin) : County :

CHECK ONE SAMPLER CATEGORY FOR WHICH THE PROBE OR SAMPLER SPECIFIED BELOW IS USED

☐ Continuous Sampler ☐ Tape Sampler ☐ Acid Deposition
☐ 24-Hour Sampler ☐ Wind Sensor ☐ Toxic Sampler

Operating Period (Enter Either Initiate or Terminate Date)

INITIATE		TERMINATE		Air Intake/Wind Sensor/Sampler Height Above Ground	Horizontal Distance Of Air Intake/Wind Sensor/ Sampler From Nearest Street
YEAR	MONTH	YEAR	MONTH	(METERS)	(METERS)

DISTANCE OF AIR INTAKE/WINDSENSOR/SAMPLER ABOVE/BELOW ROOF LEVEL

DISTANCE (METERS) ☐ ABOVE ☐ BELOW

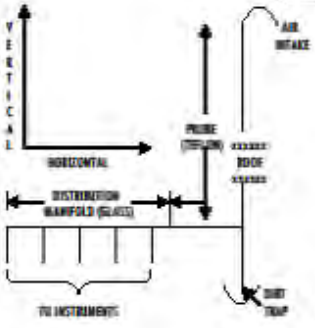
DIRECTION OF NEAREST STREET FROM AIR INTAKE/SAMPLER (CHECK ONE) :

☐ NORTH ☐ NORTHEAST ☐ EAST ☐ SOUTHEAST ☐ SOUTH ☐ SOUTHWEST ☐ WEST ☐ NORTHWEST

IF A LINE EXTENDED 30° UP FROM THE HORIZONTAL AT THE AIR INTAKE/WINDSENSOR/SAMPLER AND ROTATED 360° INTERSECTS ANY OBSTRUCTION WITHIN 20 METERS, GIVE IDENTIFYING INFORMATION BELOW

OBSTRUCTION	DIRECTION	DISTANCE (METERS)

COMPLETE FOR CONTINUOUS SAMPLING PROBES AND TAPE SAMPLERS ONLY



PROBE INSIDE DIAMETER (MILLIMETERS)	PROBE AIR FLOWRATE (L/MIN)	TOTAL PROBE LENGTH (METERS)	AIR SAMPLE RESIDENCE TIME IN PROBE (SEC.)	IF AIR INTAKE BELOW ROOF, INDICATE DISTANCE FROM WALL (METERS)

HOW MANY INSTRUMENTS SAMPLE FROM THIS PROBE	IF MORE THAN ONE INSTRUMENT IS A DISTRIBUTION MANIFOLD USED		IF YES, COMPLETE	DIST. MANIFOLD INSIDE DIAMETER	DIST. MANIFOLD LENGTH
	☐ YES	☐ NO	→		

ORIENTATION OF AIR INTAKE (CHECK ONE) : ☐ VERTICAL ☐ DOWN ☐ HORIZONTAL

PROBE MATERIAL : ☐ TEFLON ☐ GLASS ☐ OTHER, SPECIFY : _____

DISTRIBUTION MANIFOLD MATERIAL (CHECK ONE) : ☐ TEFLON ☐ GLASS ☐ OTHER SPECIFY : _____

ARB APPROVAL (INITIALS, DATE) AIR QUALITY MONITORING _____ QA _____ AIR QUALITY DATA _____
MLD Revised 3/07

APPENDIX C4
Pollutant/Project Identification Report (MLD-6)

POLLUTANT/PROJECT IDENTIFICATION REPORT
CALIFORNIA AIR RESOURCES BOARD
MONITORING AND LABORATORY DIVISION
AIR QUALITY SURVEILLANCE BRANCH

ONE OF THESE REPORTS MUST BE SUBMITTED UPON INSTALLATION OR RELOCATION OF ANY SAMPLING INSTRUMENT

REPORT COMPLETED BY: DATE: THIS REPORT: ☐ ESTABLISHES A NEW PROJECT OR POLLUTANT MONITORING ☐ AMENDS A PREVIOUS REPORT

THE INFORMATION PRESENTED BELOW WILL BE USED TO ESTABLISH THE CATEGORY (PROJECT) INTO WHICH DATA FOR SPECIFIED POLLUTANTS WILL BE ENTERED

PURPOSE OF SAMPLING (AMBIENT MONITORING, SPECIAL STUDY, ETC.):

SITE NAME (AS ASSIGNED BY ARB):

SITE ADDRESS (NUMBER, STREET, CITY)

SITE LOCATION: AIR BASIN COUNTY

AGENCY RESPONSIBLE FOR DATA SUBMITTAL:

POLLUTANT SAMPLING INFORMATION ENTERED BELOW PERTAINS TO THE "PURPOSE OF SAMPLING" DESCRIBED ABOVE

POLLUTANT SAMPLED POLLUTANT CODE POC

COLLECTION/ANALYSIS METHOD: METHOD CODE: REPORTING UNITS: UNIT CODE DURATION CODE

INSTRUMENT MANUFACTURER: MODEL NO.

SAMPLING PERIOD (ENTER EITHER INITIATE OR TERMINATE DATE) INSTRUMENT PROPERTY NUMBER (ENTER THE LAST FIVE DIGITS)

INITIATE DATE: YEAR MONTH TERMINATE DATE: YEAR MONTH

POLLUTANT SAMPLING INFORMATION ENTERED BELOW PERTAINS TO THE "PURPOSE OF SAMPLING" DESCRIBED ABOVE

POLLUTANT SAMPLED POLLUTANT CODE POC

COLLECTION/ANALYSIS METHOD: METHOD CODE: REPORTING UNITS: UNIT CODE DURATION CODE

INSTRUMENT MANUFACTURER: MODEL NO.

SAMPLING PERIOD (ENTER EITHER INITIATE OR TERMINATE DATE) INSTRUMENT PROPERTY NUMBER (ENTER THE LAST FIVE DIGITS)

INITIATE DATE: YEAR MONTH TERMINATE DATE: YEAR MONTH

ARB APPROVAL (INITIALS, DATE)

AIR QUALITY MONITORING: QA: AIR QUALITY DATA:

MLD-6 (Revised 4/97)

APPENDIX C5
Site Initiation/Termination Report

CALIFORNIA AIR RESOURCES BOARD
Monitoring & Laboratory Division
SITE INITIATION/TERMINATION REPORT

New site or parameters:
Objective – Provide reason(s) for establishing air monitoring site or initiating new parameters. Specify applicable federal or state standards, the objectives of the monitoring and expected duration of monitoring.

☐ Population Exposure ☐ General/Background ☐ Highest Concentration ☐ Regional Transport ☐ Extreme Downwind
☐ Source Oriented ☐ Max Ozone concentration ☐ Upwind Background ☐ Max Precursor Emissions Impact ☐ Welfare Related Impacts

_____
_____
_____

Sample Periods: Begin Date _____ (YYYYMMDD) End Date _____ (YYYYMMDD)

Terminate site or parameters:
Provide reason for terminating air monitoring site or parameters.

_____
_____
_____

Measurement Scale: (Check as appropriate)

Pollutant	Pollutant Code	Spacial Scale*					Monitoring Type			
		Micro	Middle	Neighborhood	Urban	Regional	NAMS	SLAMS	SPM	Other
Ozone	44201	☐	☐	☐	☐	☐	☐	☐	☐	☐
Carbon Monoxide	42101	☐	☐	☐	☐	☐	☐	☐	☐	☐
Nitrogen Dioxide	42602	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pm 2.5	88501	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other (specify in comments) _____		☐	☐	☐	☐	☐	☐	☐	☐	☐

Comments:

* Microscale = 0 M to 100 M Middle Scale = 100 M to 500 M Neighborhood Scale = 500 M to 4 KM Urban Scale = 4 KM to 50 KM Regional Scale = 50 to hundreds KM

Signatures:

Prepared by: _____ Site Name: _____
Title: _____ AQS Site Number: _____
Date: _____ Effective Date: _____

MLD-87 (03/07)