

**GASES**

**QUALITY ASSURANCE PROJECT PLAN**

**VOLUME II**

**B-002-OAQ-AMB-QA-23-Q-R3**

PREPARED BY:

Indiana Department of Environmental Management (IDEM)

Office of Air Quality (OAQ)

Air Monitoring Branch (AMB)

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**Revision 3**

**January 1, 2023**

**QAPP Revision History**

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| --- | --- | --- | --- |
| **Revision Number** | **Date** | **Responsible Party** | **Description of Change** |
| 0 | January 1, 2020 | QAS Chief | New QAPP format to replace QA Manual, which served as OAQ AMB QAPP, and was last U.S. EPA approved on March 9, 2018. |
| 1 | January 1, 2021 | QAS Chief | All Sections: Replaced LEADS with DMDS except on SOP titles; Removed NOx for required sampling gases; Removed chemiluminescence method; Designated all TSOP titles as SOP; Replaced IDEM extranet with IDEM InfoDUMP  Section 3: Added annual review for QAPP  Section 6.1: Added NO and NOy  Section 6.2: Changed calibration limit from 6 months to 182 days; Changed QC check limit from 2 weeks to 14 days; Changed BOA audit frequency from quarterly to 6 months; Changed TTP audit frequency from 3 years to 2 years  Section 6.3: Removed Chemical Speciation Network and added CASTNET Network  Section 7.1: Zero air audits changed from annual to 6 months frequency  Section 11.1: Added Thermo 49iQ to Table 10  Section 11.2.2: Added TAPI T400 and Thermo 49iQ to Table 11  Section 15: Changed residence time check from 3 years to 2 years  Section 20: Siting changed from 3 years to 2 years |
| 2 | January 1, 2022 | QAS Chief | All Sections: Removed MeteoStar; Replaced LEADS with DMDS in SOP titles  List of Acronyms – Removed LEADS  Section 4.3 – Changed QAS Environmental Manager to AMS Environmental Manager for designated person to upload one-point QC checks into AQS  Section 6.2, Table 4 – Changed CO, CO Trace, and CO2 Calibration check from monthly to every 3 months  Section 7.1, Table 8 – Changed NO2 audit level from 2 to 1; added CO2 zero air check limits = readings <10.0 ppm, absolute difference between site zero air and QA zero air <5.1 ppm  Section 11.2.2 – Added info on what sample passes through as it goes from outdoors to analyzer and cleaning information for manifold and probe lines  Section 11.2.2, Table 11 – Added Sabio 2020 EXP  Section 12.1 – This section was removed since the information is presented elsewhere in the QAPP and it doesn’t apply to chain-of-custody  Section 12.2 – This section was removed since the information does not belong here and it is presented in section 19  Section 12.3 – The information presented in this section was moved to section 10  Section 12.4 – The information presented in this section was moved to section 16  Section 15, Table 13 – Changed residence time passing from <20.0 to ≤20.0  Section 16, Table 14 – Changed limit for Gas Calibrator MFC used for calibration, span, one-point QC, and zero checks from ±1% to ±2%; changed limit for Gas Calibrator MFC used for PE audits from ±1% to ±2%.; added 11 ppm NO2 in Nitrogen Gas Cylinder used for calibration, span, one-point QC checks, and PE audits  Section 19, step 1 to 17 - Some edits to reflect new DMDS  Section 23.2, Table 18 – Added 1F  References – Added References at end of QAPP  Revisions made do not require new signatures |
| 3 | January 1, 2023 | QAS Chief | Section 4.1 = Added AMS program coordinator  Section 4.2 = Added AMS program coordinator  Section 4.3, Table 2 = Added AMS program coordinator  Section 6, Table 3 = Added SO2 secondary standard  Section 7.1, Table 7 = Changed CO2 assessment method from “one-point QC check at 160-200 ppm” to “one-point QC check at 380-420 ppm”  Section 7.1, Table 8 = Changed CO2 assessment method from “Analyzer response at approximately 750, 600, and 200 ppm” to “Analyzer response at approximately 750, 600, and 300 ppm”; Changed NO/NOy assessment method from “level 4 (0.0080-0.0199 ppm)” to “level 6 (0.0500-0.0999 ppm)”;  Changed Measured Quality Objectives for O3 from <±15.1% to <±10.1%  Section 11.1, Table 10 = Added O3, Automated Reference Method: RFOA-0216-230, TAPI T265  Section 11.2.2, Table 11 = Added TAPI T265 under O3 analyzer; Removed 43C under SO2 analyzer  Section 14, Table 12 = For AMS Calibration Results, added “If the analyzer is adjusted, the previous calibration is not valid”  Section 15, Table 13 = Under Inspection Frequency, changed “Every 3rd week per AMS loop schedule” to “Every 3 to 4 weeks per AMS loop schedule”  Section 16, Table 14 = Changed title from “Instrument Calibration/Certification and Frequency” to “Instrument Calibration/Certification/Verification and Frequency”  Section 16, Table 14 = For CO, NO, and SO2, changed “New concentration ≤±4.0% of previous certified concentration” to “QA verified concentration <±2.5% of manufacturer’s certified concentration”; Updated SOP titles; Removed “11 ppm NO2 in Nitrogen Gas Cylinder used for calibration, span, one-point QC checks, and PE audits”  Section 17 = Changed “Gas cylinder are certified by the QA Laboratory” to “Gas cylinders are verified by the QA Laboratory”. Removed NO2 cylinder information  Section 20, Table 16 = Added specific CFR requirements to ANP, Annual Data Certification, 5 Year Network Assessment, and Technical Systems Audit  Section 23.2, Table 18 = Deleted Flag Text column; deleted GC flags; and made some edits |

**List of Acronyms**

|  |  |
| --- | --- |
| **Acronym** | **Meaning** |
| °C | Degrees Celsius |
| AA | Administrative Assistant |
| AC | Assistant Commissioner |
| AMB | Air Monitoring Branch |
| AMS | Ambient Monitoring Section |
| ANP | Annual Network Plan |
| AQI | Air Quality Index |
| AQS | Air Quality System |
| ATS | Air Toxics Section |
| BOA | Back of the Analyzer |
| CAA | Clean Air Act |
| CAPS | Cavity Attenuated Phase Shift |
| CASTNET | Clean Air Status and Trends Network |
| CBSA | Core Based Statistical Area |
| CFEP | Comms Front-End Processor |
| CFR | Code of Federal Regulations |
| CO | Carbon Monoxide |
| CO2 | Carbon Dioxide |
| DMDS | Data Management and Display System |
| GCMS | Gas Chromatography Mass Spectrometry |
| GD | Guidance Documents |
| GMIS | Gas Manufacturer Intermediate Standard |
| I | Intercept |
| IDEM | Indiana Department of Environmental Management |
| INDOT | Indiana Department of Transportation |
| IR | Infrared Radiation |
| M | Slope |
| MFC | Mass Flow Controller |
| NAAQS | National Ambient Air Quality Standards |
| NCore | National Core Network |
| NIST | National Institute of Standards and Technology |
| NO | Nitric Oxide |
| NO2 | Nitrogen Dioxide |
| NOx | Oxides of Nitrogen |
| NOy | Reactive Nitrogen Compounds |
| NPAP | National Performance Audit Program |
| NTRM | NIST Traceable Reference Material |

|  |  |
| --- | --- |
| **Acronym** | **Meaning** |
| O2 | Oxygen |
| O3 | Ozone |
| OAQ | Office of Air Quality |
| OPS | Office of Program Support |
| PAMS | Photochemical Assessment Monitoring Station |
| Pb | Lead |
| PE | Performance Evaluation |
| PM | Particulate Matter |
| PM1.0 | Particulate matter having an aerodynamic diameter less than or equal to 1.0 µm |
| PM2.5 | Particulate matter having an aerodynamic diameter less than or equal to 2.5 µm |
| PM10c | Particulate matter having an aerodynamic diameter between 2.5 µm and 10 µm |
| PMT | Photomultiplier Tube |
| PQAO | Primary Quality Assurance Organization |
| PSD | Prevention of Significant Deterioration |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QAS | Quality Assurance Section |
| QC | Quality Control |
| QMP | Quality Management Plan |
| REQAS | Recycling, Education and Quality Assurance Section |
| SD | Standard Deviation |
| SIP | State Implementation Plan |
| SLAMS | State and Local Air Monitoring Stations |
| SO2 | Sulfur Dioxide |
| SOP | Standard Operating Procedure (this includes Technical Standard Operating Procedures) |
| SRM | Standard Reference Material |
| STN | Special Trends Network |
| TAD | Technical Assistance Documents |
| TAPI | Teledyne Advanced Pollution Instrumentation |
| TTP | Through The Probe |
| U.S. EPA | United States Environmental Protection Agency |
| UV | Ultraviolet |
| UVC | Ultraviolet Carbon |
| VFC | Virtual File Cabinet |
| VOC | Volatile Organic Compound |

**Section 1: Quality Assurance Project Plan (QAPP) Identification and Approval**

Indiana Department of Environmental Management (IDEM) – Office Air Quality (OAQ) – Air Monitoring Branch (AMB) – Quality Assurance Project Plan (QAPP) – Gases – Revision 3

This QAPP is designed to provide an overview of the minimum requirements for a quality assurance (QA) and quality control (QC) program for air monitoring networks which conduct gas sampling in the state of Indiana. Requiring monitoring networks to meet these criteria allows the data from all monitoring networks to be compared in a meaningful way. Gases sampled under the requirements of this QAPP include:

* Carbon Monoxide (CO)
* Carbon Dioxide (CO2)
* Nitric Oxide (NO)
* Nitrogen Dioxide (NO2)
* Reactive Nitrogen Compounds (NOy)
* Ozone (O3)
* Sulfur Dioxide (SO2)

A QC/QA program encompasses all phases of ambient air sampling and data analysis. These phases include such things as site selection, monitoring equipment selection, calibration/verification/audit equipment and procedures, sampling procedures, laboratory analysis, data verification/validation, chain of custody, data reporting, precision/accuracy reporting, and meteorological criteria. Prior to the implementation of any ambient monitoring network becoming operational, a working knowledge of this QAPP is necessary by those personnel designated as QC and QA.

There are three sections of the CFR Title 40, Protection of the Environment, which deal with Ambient Air Monitoring:

* [40 CFR Part 50](https://www.ecfr.gov/cgi-bin/text-idx?SID=a1532df110031686f2b271bd5f7fddee&mc=true&node=pt40.2.50&rgn=div5) lists the National Primary and Secondary Ambient Air Quality Standards.
* [40 CFR Part 53](https://www.ecfr.gov/cgi-bin/text-idx?SID=aebf303cc012de856ea499a901acc586&mc=true&node=pt40.6.53&rgn=div5) lists alternate equivalent air monitoring methods and procedures for obtaining equivalency.
* [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5) gives detailed descriptions of monitoring methodology, network design and siting, Prevention of Significant Deterioration (PSD) requirements, and QA criteria.

Additional federal requirements are also given in U.S. Environmental Protection Agency (U.S. EPA) Technical Assistance Documents (TAD) and U.S. EPA QA Guidance Documents (GD). Designated QC and QA personnel should maintain a working knowledge of all applicable requirements. All monitoring and QA program requirements must be kept current and accessible.

**Document Approval**

**Gases Quality Assurance Project Plan Volume II**

Indiana Department of Environmental Management

Office of Air Quality

Air Monitoring Branch

Indianapolis, IN 46219

**B-002-OAQ-AMB-QA-23-Q-R3**

**This QAPP is hereby recommended for approval and commits the Indiana Department of Environmental Management – Air Monitoring Branch to follow the elements described within.**

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**Section 3: Distribution / Notification List**

All members of the IDEM/OAQ play an important role in the collection, verification, validation, data analysis, assessment, planning, and reporting of air monitoring data. All entities that are part of this primary quality assurance organization (PQAO) are provided electronic copies of this QAPP and must adhere to the elements of the QAPP. Courtesy copies of the QAPP are also provided to those who conduct air monitoring in Indiana under their own PQAO. Table 1 shows how the QAPP is distributed. The official, controlled copy of the QAPP is available on the [IDEM air quality web page](https://www.in.gov/idem/airquality/) and the IDEM SharePoint™ QA Library. The QAPP will be reviewed annually, and documentation provided in the QAPP revision history table.

**Table 1. QAPP Distribution**

|  |  |  |
| --- | --- | --- |
| **Name** | **Organization** | **Phone** |
| Air Monitoring Branch chief | IDEM/OAQ/AMB | 317-308-3264 |
| Quality Assurance Section chief and staff | IDEM/OAQ/AMB/QAS | 317-308-3257 |
| Ambient Monitoring Section (1 and 2) chief(s) and staff | IDEM/OAQ/AMB/AMS(s) | AMS#1 317-308-3263  AMS#2 317-308-3260 |
| Air Toxics Section Chief and Staff | IDEM/OAQ/AMB/ATS | 317-308-3248 |
| Office of Program Support Recycling, Education and Quality Assurance Section chief | IDEM/OPS/REQAS | 317-234-6562 |
| Environmental coordinator | Industries conducting air monitoring in Indiana | Contact QAS Chief |
| Environmental coordinator | Consultants conducting air monitoring in Indiana | Contact QAS Chief |
| QA manager | U.S. EPA Region 5 | 312-353-2325 |
| IDEM Quality Management staff | IDEM Office of Program Support | Contact OPS REQAS Chief |

**Section 4: Project/Task Organization**

To comply with the monitoring requirements to determine if areas of Indiana meet the NAAQS and for special air monitoring studies, IDEM is the PQAO for monitoring sites designated as SLAMS, SPM, NCore/PAMS, and Near-Road.

**4.1 Staff Roles and Responsibilities**

Key functions and responsibilities in IDEM are:

1. OAQ program management: Assistant Commissioner
2. AMB management: AMB chief; AMS (1 and 2) chief(s); ATS chief; QAS chief
3. Initiate equipment and supplies request: AMS (1 and 2) environmental managers, QAS environmental managers, and ATS environmental chemists with oversight by AMS (1 and 2) chief(s), QAS chief, and ATS chief
4. Procuring of AMB equipment and supplies: Final approval by AMB chief; tracking by AA
5. Air monitoring site selection, maintenance, and operation which includes calibrations, verifications, span, zero, and QC checks: AMS environmental managers and program coordinator and ATS environmental chemists with oversight by AMS (1 and 2) chief(s) and ATS chief. As needed assistance for site selection and parameters by OAQ Programs Branch
6. Air monitoring data handling, review, verification, and retrieval requests: AMS environmental managers and program coordinator and ATS environmental chemists with oversight by AMS (1 and 2) chief(s) and ATS chief
7. Air monitoring network review and project grants: AMB chief; AMS (1 and 2) chief(s)
8. QA performance and system audits, site evaluations, data validation, and audits of data quality: QAS environmental managers and program coordinator with oversight by QAS chief
9. QA laboratory: Designated QAS environmental manager oversees most of the work performed in the QA laboratory with some assistance from other QAS environmental managers and oversight by QAS chief
10. QMP development/updates, QAPP/SOP approval; SOP agency distribution; review, authorization, and management of QA documentation (part 5 of QMP discusses documents and records): OPS
11. Programs Branch, Permits Branch, and Compliance and Enforcement Branch: utilize AMB data; see [IDEM Air Quality in Indiana](https://www.in.gov/idem/airquality/) for specific duties of these areas

**4.2 AMB Organizational Chart**

**4.3 AMB Roles and Responsibilities**

The AMB is divided among four sections (See 4.2. AMB Organizational Chart, above) which includes two site monitoring sections (AMSs), an air toxics laboratory (ATS), and a quality assurance section (QAS). Table 2 lists general duties of the positions within the AMB. The AMS #2 has an Environmental Manager designated as the AQS administrator, whose responsibilities include data submittal into AQS. Also, in the AMS #2 is an Environmental Manager designated as the DMDS administrator, whose duties include reviewing and evaluating data outputs as well as setting limits, overseeing programming within DMDS, and coordinating specific work functions of DMDS. The AMS has an Environmental Manager designated to upload one-point quality control checks in AQS. The QAS has an Environmental Manager designated to upload QA PE audits into AQS. The environmental managers/program coordinator listed under the QAS maintain separate equipment from the AMS(s) and the ATS which ensures an independent QA program. However, on occasion the QAS equipment may be used for a QC check but never to calibrate the site instruments. Data is also validated by the QAS once it has been verified by the AMS(s). The QAS maintains the QAPP(s) and has final decision on data validity.

**Table 2. Duties of Air Monitoring Branch Positions**

|  |  |
| --- | --- |
| **Position** | **Duties** |
| Air Monitoring Branch chief | Overall program management. Approves all branch expenditures. Supervises section chiefs and AA. Approves the purchase of major equipment. Approves QAPPs, SOPs, and annual certification of data. |
| Ambient Monitoring Section chiefs | Approves and ensures AMS staff adhere to the QAPPs and SOPs. Oversee and direct all ambient monitoring functions which includes calibrations; verifications; QC checks; data analysis; site location, setup, and shutdown; site maintenance; and the development or update of the ANP and 5-year network assessment. Ensures data meets quality standards. Approves annual certification of data and supervises AMS staff. |
| Air Toxics Section chief | Approves and ensures ATS staff adhere to the QAPPs and SOPs. Oversees and directs all toxic functions which include laboratory and field GCMS, instrument calibration and sample analysis. Ensures data meets QC standards. Assists with the update of the ANP and 5-year network assessment. Approves annual certification of data and supervises ATS staff. |
| Quality Assurance Section chief | Responsible for the creation, maintenance, revisions, and adherence to the QAPPs and SOPs. Oversees and directs all QA functions which include PE and systems audits, meteorological audits, toxics audits, site evaluations, and operation of the QA laboratory. Ensures data meets quality standards with authority to make final decision on data validity. Tracks the completion of corrective actions and determines the success of these actions. Approves annual certification of data and supervises QAS staff. |
| Ambient Monitoring Section environmental managers | Performs the daily operations required for the air monitoring data to be properly collected, analyzed, and verified. Performs site and equipment location setup, maintenance, shutdown. Performs calibrations, verifications, and QC checks on air monitoring field equipment; and reviews, writes, and updates SOPs. |
| Ambient Monitoring Section program coordinator | Assists with particulate monitoring chain-of-custody through logging of field-collected filters and delivery of filters to the ATS. Ships and receives filters from regional staff. Reviews, updates, and distributes QAPPs and SOPs. |

|  |  |
| --- | --- |
| **Position** | **Duties** |
| Air Toxics Section environmental chemists | Performs the daily operations required for the air monitoring data to be properly collected, analyzed, and verified. Performs site visits to conduct maintenance on air toxics monitoring equipment; and reviews, writes, and updates SOPs. |
| Quality Assurance Section environmental managers | Performs PE and systems audits, meteorological audits, toxics audits, and site evaluations. Performs maintenance, calibrations, certifications, and verifications on equipment. Validates data. Reviews, writes, and updates QAPPs and SOPs; and tracks the completion of corrective actions and determines the success of these actions. |
| Quality Assurance Section program coordinator | Assists with meteorological audits and site evaluations. Distributes, tracks, and validates data. Performs audits on the PM clean rooms. Reviews, writes, updates, and distributes QAPPs and SOPs. Communicates QA work to AMB chief for bi-weekly report, which includes SOP approval and revision updates; and tracks the completion of corrective actions and determine the success of these actions. |
| Air Monitoring Branch administrative assistant | Produces, enters, and tracks all requisitions for purchases of AMB equipment, supplies, and services in IDEM’s purchasing system. |

**Section 5: Problem Definition/Background**

In 1970, the Clean Air Act (CAA) was signed into law. This legislation authorized the development of comprehensive federal and state regulations to limit emissions from both stationary (industrial) sources and mobile sources. The NAAQS addressed six pollutants that threatened public health: SO2, NO2, PM, CO, O3, and Pb. The Board of Health was the regulatory agency in Indiana at the time of the CAA being signed into law. Since 1970, changes in types of pollutants monitored and levels have changed. However, the CAA still provides the regulations and framework for the monitoring of criteria pollutants (CO, NO2, O3, SO2, Pb, PM) by state, local, and tribal organizations through the establishment of an Air Quality Monitoring Program.

In 1986, IDEM was created. Its mission is to implement federal and state regulations to protect human health and the environment while allowing the environmentally sound operations of industrial, agricultural, commercial and government activities vital to a prosperous economy. The mission of the OAQ is to assure all Hoosiers’ ambient air quality meets the NAAQS; provide timely, quality air permits without unnecessary requirements; and to verify compliance with applicable state and federal air pollution laws and regulations. Five branches are part of the OAQ, which includes Programs, Permits, Compliance and Enforcement, Operations, and Air Monitoring. A description and a flowchart of these branches is available in the QMP at [IDEM InfoDUMP](https://ingov.sharepoint.com/sites/IDEMIntranet/SitePages/Standards,-Policies,-and-Mailcodes.aspx)

Air monitoring data is collected to:

* Demonstrate that the NAAQS are being met
* Develop, modify, or activate control strategies that prevent or reduce air pollution episodes
* Detect and analyze pollution trends throughout the state and/or region
* Provide a database for research and evaluation of effects

This QAPP covers all the gas parameters, as stated in Section 1. The QAPP is reviewed annually and updated if needed. Any SOPs associated with this QAPP are updated a minimum of every four years or if the procedures change.

**Section 6: Project/Task Description**

Air quality is regulated to protect public health and the environment in the state of Indiana and has been going on for decades. This on-going requirement to collect air monitoring data is required by regulation and is used to determine compliance with the U.S. EPA’s NAAQS. NAAQSs are identified for the criteria pollutants; CO, NO2, O3, SO2, PM2.5, PM10, and Pb. Indiana monitors CO, NO2, O3, and SO2 which have NAAQS identified (Table 3). Other gases in this QAPP which do not have established ambient standards are also monitored, including CO2,NO, and NOy. For the gases monitored, the AMB performs all this work in-house and currently does not rely on any contractual work for data results.

Measuring pollutant concentrations in outdoor air and comparing the measured concentrations to corresponding standards determines whether the ambient air quality status of an area is attaining or not attaining the standards. The NAAQS are separated into primary and secondary standards. Primary standards are those established to protect public health. Secondary standards are those established to protect the public welfare from adverse pollution effects on soils, water, vegetation, manmade materials, animals, weather, visibility, property, and economy.

The scientific criteria upon which the standards are based are reviewed periodically by the U.S. EPA, which may retain or change the standards according to its findings. Note that there are hundreds of compounds that are considered pollutants when found in ambient air but whose health and welfare effects are not well enough understood for ambient standards to be defined.

A pollutant measurement that is greater than the ambient air quality standard for its specific averaging time and level is called an exceedance. An exceedance is not necessarily a synonym for a violation. For each pollutant there are specific rules regarding the number of allowable exceedances in a given period of time. In the event the exceedances meet the NAAQS criteria to qualify as a violation, regulatory actions may result to further clean up the area’s air. The distinction between one exceedance and exceedances that result in a violation is made to allow leeway in the NAAQS for exceedances caused by unusual weather patterns or unforeseen circumstances.

The design value for a site is the pollutant concentration calculated when the NAAQS rules are applied to that specific pollutant. For example, the O3 design value is calculated by taking the annual fourth-highest daily maximum 8-hour concentration, averaged over three years. If this number is above the NAAQS, then it is a violation or ‘nonattainment’ of the NAAQS. If the design value is below the NAAQS, then the area is in ‘attainment’ of the standard. Generally, nonattainment is based on the highest design value reported for a specific geographic area (usually a CBSA), and the entire area would be defined by that monitor and classified accordingly.

Other important uses of the air monitoring data include the production of a daily AQI report, daily air quality forecast report, support of short and long-term health risk assessments, identification of a localized health concern, and tracking long-term trends in air quality.

**Table 3. NAAQS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Pollutant** | **Primary/Secondary** | **Averaging Time** | **Level** | **Form** |
| CO | Primary | 8 hours | 9 ppm | Not to be exceeded more than once per year |
| 1 hour | 35 ppm |
| NO2 | Primary | 1 hour | 100 ppb | 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| Primary and Secondary | 1 year | 53 ppb | Annual Mean |
| O3 | Primary and Secondary | 8 hours | 0.070 ppm | Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years |
| SO2 | Primary | 1 hour | 75 ppb | 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| Secondary | 3 hours | 0.5 ppm | Not to be exceeded more than once per year |

**6.1 Overview of Monitored Gas Parameters**

Gas parameter data is presented on IDEM’s internet website [IDEM Air Quality in Indiana](https://www.in.gov/idem/airquality/). Monthly and annual summary reports of parameters collected are available on the website. The DMDS provides on-line access to Indiana’s continuous air quality monitoring network. It has been available to the public since July of 2007. DMDS offers access to near real-time data from active sites and historic data from recently discontinued continuous air monitoring sites across Indiana. This allows anyone to track pollutant and meteorological values throughout the day. DMDS also includes noncontinuous PM10 and PM2.5 data. Below are the different gases which are monitored.

**Criteria Pollutants**

**Carbon Monoxide (CO)**

CO is an extremely poisonous gas that is slightly less dense than the ambient atmosphere. When introduced into the bloodstream, even at low levels, CO attaches itself to the hemoglobin in the blood, seriously disrupting the delivery of oxygen to brain and body tissue, causing unconsciousness and death. The health risk is most immediate for individuals with cardiovascular disease.

**Nitrogen Dioxide (NO2)**

NO2 is a highly toxic, reddish-brown gas that is created primarily from fuel combustion in industrial sources and vehicles. It creates an odorous haze that causes eye and sinus irritation, blocks natural sunlight, and reduces visibility.

**Ozone (O3)**

Ground-level O3, or photochemical smog, is not emitted into the atmosphere as ozone, but rather is formed by the reactions of other pollutants. The primary pollutants entering this reaction, VOCs, and oxides of nitrogen (NOx), create ozone in the presence of sunlight. Ozone is a strong irritant of the upper respiratory system and causes damage to crops.

**Sulfur Dioxide (SO2)**

SO2 is a gaseous pollutant that is emitted primarily by industrial furnaces or power plants burning coal or oil containing sulfur. At high concentrations, breathing can be impaired. Damage to vegetation can also result as SO2 is dissolved in atmospheric water droplets from where it falls as acid rain.

**Non-Criteria Parameters**

**Carbon Dioxide (CO2)**

In 2009, the U.S. EPA declared CO2 a pollutant. CO2 is the primary greenhouse gas emitted through human activities. Gases that trap heat in the atmosphere are called greenhouse gases. CO2 is naturally present in the atmosphere as part of the earth's carbon cycle. The carbon cycle is the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals. CO2 emissions come from a variety of natural sources. Human activities can influence the carbon cycle by adding more CO2 to the atmosphere and by influencing the ability of natural sinks, like forests, to remove CO2 from the atmosphere. The main human activity that emits CO2 is the combustion of fossil fuels like coal, natural gas, and oil used for energy and transportation.

**Nitric Oxide (NO)**

NO is collected as part of the NCore/PAMS requirements. This data is used in conjunction with NO2 and NOy data to help better characterize the nature and extent of the ozone problem and prepare air quality trends.

**Nitrogen Oxides (NOy)**

NOy is a collective name for oxidized forms of nitrogen in the atmosphere such as nitric oxide, nitrogen dioxide, nitric acid, and organic nitrates. This precursor gas is monitored by the NCORE/PAMS network and plays an important role in the formation of atmospheric ozone, air toxics, and particulate matter, on both local and regional scales.

**6.2 Project Schedule**

The AMB employs continuous analyzers to collect and detect samples of gases to determine the concentrations. The data are collected continuously using DMDS. The AMS calibration and QC checks on these analyzers are also performed using DMDS. Tables 4 and 5 list information outlining the specific checks performed on the gas analyzers. Specific information on the AMS checks is available in the following AMB SOP’s:

* Gas Calibration with DMDS System
* TAPI Calibrator series 700 Setup/Maintenance
* Nitrogen Species Calibration with DMDS System

Information pertaining to the QAS PE audit checks is available in the following AMB SOP’s:

* Carbon Dioxide (CO2) Audit Procedures
* Carbon Monoxide Direct Cylinder Audit Procedures
* Nitrogen Dioxide Gas Phase Titration Audit Procedures
* Ozone Audit Procedures
* Sulfur Dioxide Audit Procedures
* Zero Air Generator System Verifications and Audits

**Table 4. AMS Checks on Gas Analyzers**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Check** | **Frequency** |
| CO | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Daily |
| One-Point QC | Weekly – with no more than 14 days between two QC points |
| CO Trace | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Weekly |
| One-Point QC | Weekly – with no more than 14 days between two QC points |
| CO2 | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Daily |
| One-Point QC | Weekly – with no more than 14 days between two QC points |
| NO2 | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Daily |

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Check** | **Frequency** |
| NO2 | One-Point QC | Weekly – with no more than 14 days between two QC points |
| NO/NOy | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Weekly |
| One-Point QC | Weekly – with no more than 14 days between two QC points |
| O3 | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Daily |
| One-Point QC | Weekly – with no more than 14 days between two QC points |
| SO2 | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Daily |
| One-Point QC | Weekly – with no more than 14 days between two QC points |
| SO2 Trace | Calibration | Every 3 months – with no more than 182 days between two calibrations |
| Zero/Span | Weekly |
| One-Point QC | Weekly – with no more than 14 days between two QC points |

**Table 5. QAS PE Audit Checks on Gas Analyzers**

|  |  |
| --- | --- |
| **Parameter** | **Frequency** |
| CO, CO Trace, CO2, NO2, NO, NOy, O3, SO2, SO2 Trace | Every 6 months for BOA; TTP replaces BOA every 2 years where feasible. |

**6.3 Site Locations**

Site locations are available in the IDEM/OAQ/AMB Annual Network Plan and on the IDEM website [IDEM: Air Monitoring: Indiana’s Ambient Air Monitoring Network](https://www.in.gov/idem/airmonitoring/indianas-ambient-air-monitoring-network/). The locations and gas parameters measured will depend on the type of monitoring network. Listed below are the different air monitoring networks where gas parameters are collected.

**State and Local Air Monitoring Stations (SLAMS)**

SLAMS consist of a national network of monitoring sites where the number and distribution of sites is largely determined by the needs of state and/or local air pollution authorities.

**Special Purpose Monitoring (SPM)**

SPM sites are designed/intended for use by state and local agencies to collect supportive data for development of State Implementation Plans (SIPs) and/or other specific targeted studies such as: point source identification, control strategy effectiveness, etc. If data is used for SIP purposes, SPM sites must meet all federal and state requirements for monitoring methodology and quality assurance.

**National Core Network/Photochemical Assessment Monitoring Station (NCore/PAMS) Monitoring**

NCore is a nationwide, multi-pollutant approach to monitoring. NCore sites are intended to support multiple objectives with a greater emphasis on assessment, research support, and accountability than the traditional SLAMS networks. NCore provides an opportunity to address new directions in monitoring and begin to fill measurement and technological gaps that have accumulated in the networks. Indiana operates one urban NCore site. These sites are required to measure PM2.5, speciated PM2.5, PM10c, O3, SO2, CO, NO, true NO2, NOy, and meteorology. As of June 2021, PAMS is included at NCore sites located in a CBSA with a population of 1,000,000 or more.

**Near-Road Monitoring**

On February 9, 2010, the U.S. EPA promulgated monitoring regulations for the NO2 monitoring network. In the new monitoring requirements, state and local air monitoring agencies are required to install near-road NO2 monitoring stations at locations where peak hourly NO2 concentrations are expected to occur within the near-road environment in larger urban areas. Site selection is required to consider traffic volumes, fleet mix, roadway design, traffic congestion patterns, local terrain, and meteorology in determining where a required near-road NO2 monitor should be placed. Indiana operates one near-road monitoring site. IDEM worked with the INDOT to obtain a location for the site. The near-road site is required to measure NO2, CO, O3, and meteorology. Toxics VOCs and particulates, such as PM2.5, PM1.0, and continuous speciation (black carbon/UVC) are also measured at this site.

**Clean Air Status and Trends Network (CASTNET)**

CASTNET is a national monitoring network established to assess trends in pollutant concentrations, atmospheric deposition, and ecological effects due to changes in air pollutant emissions. The two CASTNET sites in Indiana are operated by U.S. EPA and are maintained by U.S. EPA contractors. The CASTNET sites report O3 data, and the QAS will visit each site annually for a third-party PE audit.

**Section 7: Quality Objectives and Criteria for Measurement Data**

The primary data quality objective, which is adopted from those established by the U.S. EPA, is to ensure that the data collected by the AMB are consistent, of known and adequate quality, supported by adequate calibrations and evaluations, and sufficiently complete to describe the atmospheric state with respect to spatial and temporal distribution. Minimum QA requirements are listed in [40 CFR part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5) and its appendices. The data must meet the quality goals for representativeness, precision, bias, detectability, completeness, and comparability. Accuracy has been a term frequently used to represent closeness to “truth” and includes a combination of precision and bias error components. This term had been used throughout the CFR but has been replaced with bias when there is the ability to distinguish precision from bias. The quality system for the AMB air monitoring program focuses on understanding and controlling, as much as possible, measurement uncertainty and because of that, mainly focuses on precision, bias, detectability, completeness, and comparability. Representativeness is addressed through network designs and is not something that the quality system can control through better measurements.

Collecting quality data begins with properly trained staff and adequate funding to provide the necessary equipment that meets the required performance specifications. High quality data also relies on having adequate supplies available, safe monitoring locations that meet U.S. EPA siting requirements, and approved QAPP(s) and up-to-date SOPs.

Table 6 lists the objectives and how the AMB approaches each one.

**Table 6. Objective/Approach**

|  |  |
| --- | --- |
| **Objective** | **Approach** |
| Representativeness | The data collected will represent ambient air that the public is exposed to. Monitoring locations are selected to meet this objective and adhere to U.S. EPA requirements for siting. All sample inlets must be the proper height above the ground, and have a minimum distance from objects that could affect the representativeness of the results of the data collected as described in [40 CFR part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5) Appendix E. The QAS uses a site evaluation form which has all the requirements as detailed in the Site Evaluation Procedures SOP. Examples of siting include:   * Minimum of 10 meters from the dripline of trees * Distance from sampler to any obstruction must be twice the height that the obstruction protrudes above the sampler * Inlet height 2 to 15 meters above ground except for CO microscale, which is 2.5 to 3.5 meters above ground   Special purpose monitoring, Near-Roadway monitoring, and industrial-based monitoring have different siting requirements designed to meet these special monitoring objectives. |
| Precision | Precisions is a measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation. For gas samplers, this is estimated from one-point quality control checks. See [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5) Section 2.3. |
| Bias | Bias is the systematic or persistent distortion of a measurement process which causes errors in one direction. For gas samplers this is estimated from one-point quality control checks. See [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5) Section 2.3. |
| Detectability | The determination of the low range critical value of a characteristic that a method specific procedure can reliably discern. Maximum limits also apply since most instruments have a maximum value that they can provide accurately. For the AMB gases program, U.S. EPA MDLs are adopted. |

|  |  |
| --- | --- |
| **Objective** | **Approach** |
| Completeness | The AMB strives to obtain the highest level of data capture or completeness as possible. Data completeness is defined as the number of valid measurements (meeting all QC and QA criteria) divided by the number of possible or scheduled measurements. All data must meet a minimum of 75% completeness. |
| Comparability | Ambient air monitoring is conducted in adherence to the established methods as published in 40 CFR Part 50 and 53 for national consistency and comparability. Participation in the National Performance Audit Program (NPAP), Ambient Air Protocol Gas Verification Program (for more information, see U.S. EPA Ambient Monitoring Technology Information Center, [Ambient Monitoring Technology Information Center](https://www.epa.gov/amtic), and the AMB Calibration, Certification, and Verification Methods of Transfer Standards QAPP), as well as conference calls help ensure comparability. In addition, those who operate under their own PQAO in Indiana and submit air monitoring data into AQS will be subject to an annual third-party evaluation by the QAS. |

**7.1 Measurement Quality Objectives**

To ensure the quality of the data, sampler calibrations, spans, zeroes, and one-point QC checks are performed by the AMS using equipment that meets calibration/certification/verification requirements. These are performed on a set schedule automatically programmed into DMDS. Additional calibrations, spans, zeroes, and one-point QC checks can be manually programmed by AMS parameter specialists when the analyzer fails its warning limit or when there is concern on the accuracy of the data collection. Any failed check will flag data values starting from the last passing check until a new check passes. Although this data is initially flagged, it may be shown to be valid afterwards, which the parameter specialist can remove the null code. All these checks help determine the validity of the data by ensuring that the analyzers meet specific limits. The DMDS also has additional checks, such as linearity and precision, which must meet specific limits to pass. All analyzers require a calibration after maintenance which can affect the output of the analyzer. Additional PE audits are performed independently by QAS. The QA results provide statistical analysis of the data and determine the accuracy of the data. There are some instances where the QAS will run a one-point QC concentration, usually when AMS has equipment issues or additional information is needed on the data. As part of the PE, the QAS also performs zero air audits every six months. Tables 7 and 8 list the types of checks as well as the limits. Additional information as well as calculations are provided in the AMB SOPs listed in section 6.2 of this QAPP.

**Table 7. AMS Methods Data Assessment Requirements**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Check: Calibration, span, zero, and one-point QC** | | | |
| **Parameter Method** | **Assessment Method** | | **Measured Quality Objectives** |
| CO | Analyzer response to standard gas for calibration on 0-20 ppm range (CO trace at 0-5 ppm range); span at 70-90% of full range; zero; one-point QC check at 0.5-5.0 ppm  NOTE: DMDS calibrator stability is 0.10 ppm for these checks to be valid. | | Calibration points < ±2.1% from best fit line and slope warning at ±5.0% and failure at ±7.0% of perfect slope; Span drift warning at ±8.0% and failure if not < ±10.1%; zero drift warning at ±0.4 ppm and failure if not < ±0.61 ppm; One-point QC warning at ±8.0% and failure if not < ±10.1% |
| CO2 | Analyzer response to standard gas for calibration on 0-1000 ppm range; span at 70-90% of full range; zero; one-point QC check at 380-420 ppm | | Calibration points < ±2.1% from best fit line and slope warning at ±5.0% and failure at ±7.0% of perfect slope; Span drift warning at ±8.0% and failure if not < +10.1%; zero drift warning at ±8.0 ppm and failure if not < ±10.0 ppm; One-point QC warning at ±8.0% and failure if not < ±10.1% |
| NO2 | | Analyzer response to standard gas for calibration on 0-0.2 ppm range; span at 70-90% of full range; zero; one-point QC check at .005-0.08 ppm  NOTE: DMDS calibrator stability is 1.0 ppb for these checks to be valid. | Calibration points < ±2.1% from best fit line and slope warning at ±5.0% and failure at ±7.0% of perfect slope; Span drift warning at ±8.0% and failure if not < +10.1%; zero drift warning at ±3.0 ppb and failure if not < ±5.1 ppb; One-point QC warning at ±10.0% and failure if not < ±15.1% |
| NO/NOy | | Analyzer response to standard gas for calibration on 0-0.2 ppm range; span at 70-90% of full range; zero; one-point QC check for NOy at .005-0.08 ppm  NOTE: DMDS calibrator stability is 1.0 ppb for NOy checks to be valid. | Calibration points < ±2.1% from best fit line and slope warning at ±5.0% and failure at ±7.0% of perfect slope; Span drift warning at +8.0% and failure if not < +10.1%; zero drift warning at ±3.0 ppb and failure if not < ±5.1 ppb; One-point QC warning at ±8.0% and failure if not < +10.1% |
| **Parameter**  **Method** | | **Assessment Method** | **Measured Quality Objectives** |
| O3 | | Analyzer response to standard gas for calibration on 0-0.2 ppm range; span at 70-90% of full range; zero; one-point QC check at .005-0.08 ppm  NOTE: DMDS calibrator stability is 1.0 ppb for these checks to be valid. | Calibration points < ±2.1% from best fit line and slope warning at ±5.0% and failure at ±7.0% of perfect slope; Span drift warning at ±5.0% and failure if not < ±7.1%; zero drift warning at ±3.0 ppb and failure if not < ±5.1 ppb; One-point QC warning at ±5.0% and failure if not < ±7.1% |
| SO2 | | Analyzer response to standard gas for calibration on 0-0.2 ppm range (SO2 trace range 0-0.1 ppm); span at 70-90% of full range; zero; one-point QC check at .005-0.08 ppm  NOTE: DMDS calibrator stability is 1.0 ppb for these checks to be valid. | Calibration points < ±2.1% from best fit line and slope warning at ±5.0% and failure at ±7.0% of perfect slope; Span drift warning at ±8.0% and failure if not < 10.1%; zero drift warning at ±3.0 ppb and failure if not < ±5.1 ppb; One-point QC warning at ±8.0% and failure if not < 10.1% |

**Table 8. QAS Methods Data Assessment Requirements**

|  |  |  |
| --- | --- | --- |
| **Type of Check: PE Audit** | | |
| **Parameter Method** | **Assessment Method** | **Measured Quality Objectives** |
| CO | Analyzer response at level 4 (0.900-2.999 ppm), level 5 (3.000-7.999 ppm), level 6 (8.000-15.999 ppm); CO trace checks at level 2 (0.060-0.199 ppm), level 4 (0.900-2.999 ppm), level 5 (3.000-7.999 ppm) | Percent difference of audit levels 3-10 <±15.1%; Audit levels 1&2 <±.03 ppm difference or <±15.1% |
| CO2 | Analyzer response at approximately 750, 600, and 300 ppm | Percent difference of audit levels <±15.1% |
| NO2 | Analyzer response at level 1 (0.0003-0.0029 ppm), level 5 (0.0200-0.0499 ppm), level 7 (0.1000-0.2999 ppm); | Percent difference of audit levels 3-10 <±15.1%; Audit levels 1&2 <±1.5 ppb difference or <±15.1% |

|  |  |  |
| --- | --- | --- |
| **Parameter**  **Method** | **Assessment Method** | **Measured Quality Objectives** |
| NO/NOy | NOy at level 1 (0.0003-0.0029 ppm), level 6 (0.0500-0.0999 ppm), level 7 (0.1000-0.2999 ppm) | Percent difference of audit levels 3-10 <±15.1%; Audit levels 1&2 <±1.5 ppb difference or <±15.1% |
| O3 | Analyzer response at level 2 (0.006-0.019 ppm), level 4 (0.040-0.069 ppm), level 6 (0.090-0.119 ppm) | Percent difference of audit levels 3-10 <±10.1%; Audit levels 1&2 <±1.5 ppb difference or <±10.1% |
| SO2 | Analyzer response at level 2 (0.0030-0.0049 ppm), level 3 (0.0050-0.0079 ppm), level 6 (0.0500-0.0999 ppm); SO2 trace checks at level 1 (0.0003-0.0029 ppm), level 2 (0.0030-0.0049 ppm), level 6 (0.0500-0.0999 ppm) | Percent difference of audit levels 3-10 <±15.1%; Audit levels 1&2 <±1.5 ppb difference or <±15.1% |
| Zero Air | Zero check | CO/CO Trace = readings <100.0 ppb, absolute difference between site zero air and QA zero air <50.5 ppb; CO2 = readings <10.0 ppm, absolute difference between site zero air and QA zero air <5.1 ppm; NO/NO2/O3/SO2 = readings <1.0 ppb, absolute difference between site zero air and QA zero air <1.5 ppb; NO2 at NCORE = readings <0.50 ppb, absolute difference between site zero air and QA zero air <0.505 ppb; SO2 Trace = readings <0.200 ppb, absolute difference between site zero air and QA zero air <0.2005 ppb |

Note: QA Audit levels can be found at the link below or refer to [40 CFR Part 50](https://www.ecfr.gov/cgi-bin/text-idx?SID=a1532df110031686f2b271bd5f7fddee&mc=true&node=pt40.2.50&rgn=div5) Appendix A Section 3.1.2. <https://aqs.epa.gov/aqsweb/documents/codetables/audit_levels.html>

The QAS chief will confirm what levels to use for the upcoming year by using previous year’s data. In most instances these audit levels will remain the same.

**7.2 National Performance Audit Program (NPAP) Audits**

The primary objective of the independent NPAP audits is to assess the bias and imprecision of the measured ambient concentration of criteria pollutant gases reported by monitoring sites. The U.S. EPA Region 5 or their designated contractor performs these audits. Requirements for NPAP audits are detailed in [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5) Appendix A Section 3.1.3 and other posted NPAP implementation GD’s. Audit results are reported to AQS by the U.S. EPA Region 5 or the designated contractor.

**7.3 Sampler Through the Probe (TTP) Audits**

The QAS will perform TTP audits on each gas analyzer on a 2-year cycle, where feasible. This TTP audit will be reported as a PE audit and replace the BOA audit. These results will help determine the accuracy of the data collected from the probe inlet through the full sample path.

**Section 8: Training**

Formal staff training is scheduled to train new employees and periodically update employees' skills and program operations. Required training consists of QAPP and SOP review, air monitoring instrument manuals and corresponding SOPs, and hands-on training on air monitoring instruments which are related to the required work for specific staff (e.g., GC for ATS staff, PM2.5 FRM for AMS staff, O3 verifications for QAS staff). Formal staff training is coordinated with the section chiefs, senior level staff, or parameter specialists of the AMS, QAS, and ATS of the AMB on an as needed basis for those persons(s) engaged in the following: operating, calibrating, verifying, validating, and auditing analyzers or samplers; laboratory procedures; field duties; safety; and any other items related to work performed by staff in the AMB. The training for staff is tracked and documented by the individual section chiefs, except for any in-house training pertaining to computer safety, which is documented by the Indiana State Personnel Department but able to be tracked by individual section chiefs. Standard literature references are readily available to all staff members including the Federal Register, manufacturer's instrument manuals, and QA GDs related to the program objectives. Courses and other training are also provided through U.S. EPA AirKnowledge (<https://airknowledge.gov/>) and vendors.

**Section 9: Documentation and Records**

The goal of IDEM is to collect data that are accurate and representative of the actual conditions. For this to occur, documentation and record keeping must be performed at a high level of accuracy and be consistent amongst all participants who are part of the PQAO. The AMB shared drive is only available to AMB staff which helps secure any tampering issues. Documents on the IDEM InfoDUMP can only be seen by IDEM staff. Documents on the IDEM InfoDUMP and IDEM webpage can only be changed by the IDEM computer staff. Documentation in DMDS is secure and cannot be changed once entered. Data in DMDS can be changed only by AMS(s) Chiefs and staff. This procedure is provided in the AMB SOP “Gaseous Data Validation Using DMDS”. The QA laboratory cabinet, which stores paperwork for calibrations, certifications, and verifications, is in a secure location with limited access to others. Table 9 summarizes what documentation is involved, location of these documents, retention time, and the main custodian. All records are either kept at the minimum requirements as addressed in the IDEM QMP or kept indefinitely.

**Table 9. Documentation and Records**

|  |  |  |  |
| --- | --- | --- | --- |
| **Document** | **Location** | **Retention Time** | **Custodian** |
| ANP; 5 Year Network Plan; QAPP | IDEM internet and InfoDUMP; AMB shared drive | Latest on IDEM internet and InfoDUMP; AMB shared drive maintains previous versions | ANP and 5 Year Network Plan – AMS (1 and 2) Chief(s); QAPP – QAS Chief |
| SOPs | IDEM InfoDUMP; AMB shared drive | Latest on IDEM InfoDUMP; AMB shared drive maintains previous SOPs | QAS Program Coordinator and OPS |
| Logs | Operators log available through DMDS | Kept indefinitely | AMS Environmental Manager DMDS Administrator |
| CO, CO2, NO/NO2/NOy, O3, SO2 audit forms | AMB shared drive | Kept indefinitely | QAS Environmental Manager |
| Data, calibration, span, zero, one-point QC check | DMDS | DMDS maintains data indefinitely | AMS Environmental Manager DMDS Administrator |
| AMS exceedance reports | AMB shared drive | Kept indefinitely | AMS Environmental Manager |
| QAS data memos; data checks; exceedance reports; and site evaluations | AMB shared drive; VFC; site evaluation record also on DMDS | Kept indefinitely | QAS Chief and Program Coordinator |
| Calibrations, certifications, and verifications performed by the QA laboratory | AMB shared drive | Information kept at least 3 years unless item is still in circulation then information is kept indefinitely | QA Laboratory Manager |
| NIST-traceable calibrations, certifications, and verifications performed by other standards laboratories | QA laboratory cabinet file | Kept indefinitely | QA Laboratory Manager |
| NPAP audit results | AMB shared drive; DMDS | Kept indefinitely | QAS Chief and QAS Environmental Manager |
| TSA questionnaire, audit finding response form, and final report and closeout letter | AMB shared drive | Kept indefinitely | QAS Chief and QAS Program Manager |

**Section 10: Network Description (or Sampling Process Design)**

Gas sampling is primarily conducted in population centers per U.S. EPA requirements. Additional sites are also operated to establish rural background concentrations, provide statewide as well as regional coverage, and for areas of specific interest, such as sources and near road. The IDEM ANP provides information on sites and can be found at <https://www.in.gov/idem/airquality/>.

Network design and sampler siting is established based on [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5), Appendices D and E, site evaluations, and is mentioned in Sections 6 and 7 of this QAPP.

When photographs or digital images are taken for purposes of documenting and to support a field investigation, such as a QAS site evaluation, then a record of each exposure or image will be saved as a file on the AMB computer shared drive. The following information will be recorded:

* The site name and what it shows will be part of the file name, which will be stored based on the year it was taken. For example, file name “Gary IITRI SE” stored under the path QA\Site Information\Site Evaluations\Gary IITRI\2020.
* The name of the individual who took the photograph or digital image will correspond to any paperwork, such as a site evaluation. If no paperwork is used, a log entry on DMDS is adequate.

**Section 11: Sampling Method Requirements**

Sampling equipment and procedures follow [40 CFR Part 50](https://www.ecfr.gov/cgi-bin/text-idx?SID=a1532df110031686f2b271bd5f7fddee&mc=true&node=pt40.2.50&rgn=div5), Appendices A, C, D, and F. Specific instructions on technical aspects of these procedures can be found in the equipment manual for each analyzer as well as the following AMB SOPs;

* Continuous Air Monitoring Site Setup
* Continuous Air Monitoring Station (CAMS) Shelter Maintenance
* Gas Calibration with DMDS System
* Nitrogen Species Calibration with DMDS System
* Oxides of Carbon Monitor Annual Preventative Maintenance
* Running Field Loop
* Sulfur Dioxide (SO2) Analyzer Maintenance
* TAPI Calibrator series 700 Setup/Maintenance
* Teledyne API 200EU 501Y NO-NOY Analyzer Maintenance
* Teledyne Cavity Attenuated Phase Shift (CAPS) Model T500U NO2 Analyzer Maintenance and Troubleshooting

The AMB maintains a complete set of SOPs for all procedures, which is available through the AMB shared computer drive and the [IDEM InfoDUMP](https://ingov.sharepoint.com/sites/IDEMIntranet/SitePages/Standards,-Policies,-and-Mailcodes.aspx).

**11.1 Sampling Equipment**

The AMB utilizes continuous analyzers that meet established federal reference method or equivalent method requirements except for some gas sampling designated as non-criteria (see table 10). Documentation of changing out instrumentation or a method change at a site is made in the site DMDS program. Any method changes are also reflected in AQS.

**Table 10. Gas Sampling Equipment**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Reference Method** | **Monitor Type** |
| CO  CO Trace | Automated Reference Method: RFCA-1093-093 | TAPI T300  TAPI T300U |
| CO2 | No Federal Reference Method | TAPI T360 |
| NO2 | Automated Equivalent Method: EQNA-0514-212 | TAPI T500U |
| NO/NOy | Automated Reference Method: RFNA-1194-099 | TAPI T200U |
| O3 | Automated Equivalent Method: EQOA-0992-087 | TAPI T400 |
| Automated Reference Method: RFOA-0216-230 | TAPI T265 |
| Automated Equivalent Method: EQOA-0880-047 | Thermo Scientific 49C  Thermo Scientific 49i  Thermo Scientific 49iQ |
| SO2  SO2 Trace | Automated Equivalent Method: EQSA-0486-060 | Thermo Scientific 43i  Thermo Scientific 43iQ  Thermo Scientific 43i-TLE |

**11.2 Sampling Methodology**

Below is a summary on the method of how each gas is analyzed. Specific concepts and procedures are provided in the instrument’s operating manual

**11.2.1 Gases**

* CO– CO absorbs infrared radiation (IR) at known frequencies. When IR passes through a sample cell, the CO absorbs a portion of the IR. This measurement method compares the amount of IR passing through the sample cell with the amount of IR passing through a CO free reference cell. Next, the method converts this difference in IR absorption passing through the two cells to an output signal.
* CO2 – CO2 absorbs IR at known frequencies. When IR passes through a sample cell, the CO2 absorbs a portion of the IR. This measurement method compares the amount of IR passing through the sample cell with the amount of IR passing through a CO2 free reference cell. Next, the method converts this difference in IR absorption passing through the two cells to an output signal.
* NO2 – The Cavity Attenuated Phase Shift (CAPS) NO2 monitor operates as an optical absorption spectrometer yielding direct measurements of ambient nitrogen dioxide down to sub ppb concentrations. The CAPS method uses light from a blue ultraviolet light emitting diode centered at 450 nm, a measurement cell with high reflectivity mirrors located at both ends to provide an extensive optical path length, and a vacuum photodiode detector. These components are assembled within an optical cell which resides in a temperature-controlled oven. The oven raises the ambient temperature of the sample gas to 45°C to reduce the formation of moisture on the surfaces of the mirrors, while also minimizing changes in the absorption coefficient due to temperature fluctuations. The CAPS method measures NO2 directly, using optical absorption, a phenomenon that is well-defined by Beer’s Law, where the absorbance is directly proportional to both the path-length and concentration of the absorbing gas.
* NO/NOy – NOy has been identified as precursors for the formation of both O3 and PM2.5. NOy consists of all oxides of nitrogen in which the oxidation state of the nitrogen atom is +2 or greater. NOy refers to the sum of all reactive nitrogen oxides including NOx (NO + NO2) and other nitrogen oxides referred to as NOz. The major components of NOz include nitric acid (HNO3), nitrous acid (HONO), organic nitrates [peroxyl acetyl nitrate (PAN), methyl peroxyl acetyl nitrate (MPAN), and peroxyl propionyl nitrate, (PPN)], and particulate nitrates. The same principle used for the measurement of NO, NO2, and NOx is used for the total reactive oxide’s measurement. The NO and NOy concentrations are determined by photochemically measuring the light intensity at wavelengths greater than 600 nanometers from the chemiluminescent reaction of NO with O3. To measure NOy, sample air is passed through a probe-mounted catalytic converter. The nitroxyl compounds present are reduced to NO. The NO already in the air sample is not affected by the converter.

The NO resulting from the reduction of these nitroxyl compounds, plus any native NO is directed to a reaction chamber to react with O3. The intensity of the resulting chemiluminescent light is measured as the total NOy concentration. To measure NO separately and specifically, sample air by-passes the catalytic converter so that no reduction of the nitroxyl compounds to NO occurs. This procedure is like the methodology used to measure NOx; however, it uses a higher converter temperature to more completely convert NOz species, and the converter is moved near to the sample inlet to avoid line losses of “sticky” NOy species, such as HNO3.

* O3 – The method used to monitor O3 is based on the Beer-Lambert principle that O3 absorbs ultraviolet light. The greatest absorbance takes place at the 253.7 nm wavelength. A low-pressure mercury vapor lamp produces light at this wavelength. This light is admitted into a measuring cell. Ozonated (sample) air and nonozonated (zero) air are alternately passed through the sample cell. The UV radiation passes through the sample and is absorbed by ozone. The strength of the UV signal detected after passing through the sample air is directly proportional to the O3 concentration. The T265 analyzer is designed to measure the concentration of ozone using the chemiluminescence reaction below. The signal comes from the light emitted by the gas phase reaction of nitric oxide (NO) and ozone. The reaction of ozone with NO results in electronically excited NO2 \* molecules. The excited NO2 \* molecules release their excess energy by emitting a photon hν and dropping to a lower energy level. It has been shown that the number of emitted photons is directly proportional to the O3 concentration in the sample stream.
* SO2 – The pulsed fluorescence method of measuring ambient levels of SO2 involves the reaction of SO2 with UV light. Sample air passes through a catalyst that conditions the sample by scrubbing out aromatic hydrocarbons. The air sample is drawn into the sample reaction cell in which the fluorescent measurement takes place. The UV excitation of SO2 in the air sample creates a fluorescent light output proportional to the SO2 concentration. A PMT measures the fluorescent light output. The current output of the PMT is processed by an electrometer amplifier that sends a voltage to the analyzer output terminals. This voltage may be adjusted to correspond to SO2 concentrations in the reaction cell.

**11.2.2 Shelter Types and Temperature Requirements**

Gas analyzers, calibrators, and zero air systems are located inside a shelter, e.g., an IDEM air monitoring trailer, or a room located inside a building. Probes and manifolds, which these gases pass through, consists of one of the following setups:

1. CAS Shelters – Glass manifold with Teflon cap.
2. Ekto Shelters – Glass funnel with ½” Teflon tubing and glass manifold.
3. Single O3 without manifold – Glass funnel with ¼” Teflon tubing.

For all these setups, ambient air is drawn in by a pump, then passes through a solenoid, an inline filter, then into the analyzer. For calibrations, spans, zeroes, and one-point QC checks, the assessment concentration passes through the same solenoid, then through the same inline filter, before entering the analyzer. The audit setup for a BOA audit will have the assessment concentration enter through as much of the indoor plumbing as possible but must at least pass through the inline filter before entering the analyzer. A TTP audit has the audit gas enter from the candy cane and pass through the solenoid, inline filter, then the analyzer. The manifold and probe lines must be kept clean. These will be cleaned if dirt is present but will also be cleaned on a schedule. The manifolds are cleaned at least once a year. The probe lines are replaced as needed but no more than four years between replacing the line.

The analyzers, calibrators, and zero air systems are required to operate under specific temperatures. These temperatures are maintained by the shelter thermostat and the HVAC equipment. Maintenance of the shelter and HVAC system is performed by AMS staff or through a contractor. Table 11 lists the temperature range required for each type of equipment for data collected to be valid. The standard deviation limit is to provide temperature stability information and is not necessarily an indication of a temperature infraction resulting in invalid data. Also listed in table 11 are the temperature limits for audit equipment used by the QAS.

**Table 11. Gas Analyzer, Calibrator, Zero Air System Indoor Temperature Requirements**

|  |  |  |
| --- | --- | --- |
| **Item** | **Make/Model** | **Temperature Range** |
| CO analyzer | TAPI T300 | 10.0 – 40.0°C; < 2.1°C SD over 24 hours |
| CO Trace analyzer | TAPI T300U | 10.0 – 40.0°C; < 2.1°C SD over 24 hours |
| CO2 analyzer | TAPI T360 | 10.0 – 40.0ºC; < 2.1°C SD over 24 hours |
| NO/NOy analyzer | TAPI T200U | 20.0 – 30.0ºC; < 2.1°C SD over 24 hours |
| NO2 analyzer | TAPI T500U | 5.0 – 40.0ºC; < 2.1°C SD over 24 hours |
| O3 analyzer | Thermo 49C  Thermo 49i  Thermo 49iQ  TAPI T400  TAPI T265 | 5.0 – 40.0ºC except Thermo 49iQ which is 0.0 – 45.0ºC; < 2.1°C SD over 24 hours |
| **Item** | **Make/Model** | **Temperature Range** |
| SO2 analyzer | Thermo 43i  Thermo 43iQ | 20.0 – 30.0ºC except Thermo 43iQ which is 0.0 – 45.0ºC; < 2.1°C SD over 24 hours |
| SO2 Trace analyzer | Thermo 43i-TLE | 20.0 – 30.0ºC; < 2.1°C SD over 24 hours |
| Calibrator | Environics 6103 | 15.0 – 30.0°C |
| Calibrator | ESC 7700P | 5.0 – 43.0°C |
| Calibrator | Sabio 2010 | 5.0 – 40.0°C |
| Calibrator | Sabio 4010 | 5.0 – 40.0°C |
| Calibrator | Tanabyte 724 | 5.0 – 40.0°C |
| Calibrator | TAPI T50U | 5.0 – 40.0°C |
| Calibrator | TAPI T703U | 5.0 – 40.0°C |
| Calibrator | TAPI T700U | 5.0 – 40.0°C |
| Calibrator | Thermo 49i-PS | 0.0 – 45.0ºC |
| Zero Air System | CSI 205 | 15.0 – 35.0°C |
| Zero Air System | EESI 2000 | 4.4 – 65.6°C |
| Zero Air System | Perma Pure | -20.0 – 40.0°C |
| Zero Air System | Sabio 2020  Sabio 2020 EXP | 10.0 – 30.0°C |
| Zero Air System | TAPI 701 | 5.0 – 40.0°C |
| Zero Air System | TAPI 751H | 5.0 – 40.0°C |

**11.3 Failed Sample Events**

In the event of a malfunctioning analyzer that was not collecting data according to specific requirements, the AMS will provide information into the DMDS, giving detailed information why the data is invalid (flagged with a null code) or if a QA qualifier is applied to the data. This information is also made available in AQS. If the QAS finds an issue, then a memo will be sent to the AMS, who will then confirm the results. A detailed log is also entered in DMDS by the QAS for the specific site.

**Section 12: Sample Handling and Custody**

Measurements of all the continuous gases are collected in-situ year-round. As no physical samples are collected, chain-of-custody procedures do not apply.

**Section 13: Analytical Methods**

For gas parameters, the monitoring methods are “self-contained” within the apparatus (analyzer) as described in Section 11.1 and no additional analyses at a laboratory are required.

**Section 14: Quality Control Requirements**

Field sampling quality control and acceptance criteria is detailed in Section 7.1 of this QAPP. Limits for spans, zeroes, and one-point QC checks are calculated within DMDS. The QAS and NPAP audit results are calculated independently of DMDS. SOPs describe these procedures and are mentioned throughout this QAPP, are available on the AMB shared computer drive, and also listed at the IDEM website, <https://ingov.sharepoint.com/sites/IDEMIntranet/SitePages/Standards,-Policies,-and-Mailcodes.aspx>. Table 12 lists the action taken when results do not meet measured quality objectives.

**Table 12. Measured Quality Objective Checks and Outcomes**

|  |  |
| --- | --- |
| **Check** | **Outcome** |
| AMS Calibration Frequency | If more than 182 days have passed, data will be assigned a QA qualifier “1” until a calibration is performed if spans/zeros/One-Point QC checks indicate accurate data. If additional checks are not available or there is evidence of inaccurate data, data are invalid after 182 days until a new calibration is performed. Data is replaced with an “EC” null data qualifier. |
| AMS Calibration Results | If a calibration fails, further review of the data and the condition of the site calibrator and zero air system may result in a QA qualifier, a null data qualifier, or void the calibration. Data collection moving forward may use the previous passing calibration slope and intercept until a new passing calibration occurs (see AMS calibration frequency above if the next passing calibration goes beyond 182 days). If the analyzer is adjusted, the previous calibration is not valid. |
| AMS Zero Frequency | If a zero check has been missed, the condition of the data will be evaluated, which may include reviewing the next zero air check, one-point QC check, PE audit, data comparison among sites, and the gas trace. Any suspicion of the condition of the data may require a QA qualifier or a null data qualifier. |
| AMS Zero Results | If a zero check fails, further review of the data and the condition of the site calibrator and zero air system may result in a QA qualifier, a null data qualifier, or void the zero air check. |
| AMS Span Frequency | If a span check has been missed, the condition of the data will be evaluated, which may include reviewing the next span, one-point QC check, PE audit, data comparison among sites, and the gas trace. Any suspicion of the condition of the data may require a QA qualifier or a null data qualifier. |
| AMS Span Results | If a span check fails, further review of the data and the condition of the site calibrator and zero air system may result in a QA qualifier, a null data qualifier, or void the span check. |
| AMS One-Point QC Frequency | If a one-point QC check is missed in a 14-day period, data may be assigned a QA qualifier “1” if other checks indicate accurate data. Any indication of an issue may warrant a null data qualifier on the data starting from the last passed span or one-point QC check up to a new passing span or one-point QC point. |

|  |  |
| --- | --- |
| **Check** | **Outcome** |
| AMS One-Point QC Results | If a one-point QC check fails, data are invalid using appropriate null data qualifier back to last passing span or one-point QC check, unless there is sufficient evidence to indicate otherwise. On occasion issues with the calibration system may result in the one-point QC check being invalid. In either situation, a 1C and a 1F null code will be used for the one-point QC transaction to identify calibration system issues (1C) or a failed QC audit (1F). |
| DMDS internal checks for stability | Any failure of these will void an AMS assessment check. |
| QAS Audit Frequency | If an audit is missed, then the next audit will occur as scheduled. Additional audits may be performed based on maintenance being performed on AMS equipment to improve results or for troubleshooting. |
| QAS Audit Results | If QAS audit results do not meet specifications, data are suspect. The AMS must follow up with a check, such as a span, zero, one-point QC check, and if needed a calibration. Condition of the data will be determined after further review of additional checks. Audit equipment may be evaluated in the QA Standards Laboratory and if there is indication the equipment is not accurate then the audit will be voided, and data will stand as is until further checks can be performed |
| NPAP Audit | If NPAP results do not meet specifications, data are suspect from the last calibration of the analyzer up to the issue being resolved. The AMS must follow up with some action, such as maintenance, one-point QC check, etc. QAS may assist. |

**Section 15: Instrument/Equipment Testing, Inspection, and Maintenance Requirements**

Analyzers, calibrators, zero air systems and any other items that are part of the data collection process (this includes anywhere the sample gas comes into contact) must have checks and routine preventive maintenance performed to ensure proper operation. Most manufacturers supply a preventive maintenance checklist with the instruction manual. A specific schedule is shown in table 13. When new equipment arrives, it is checked prior to field use to ensure all diagnostics meet manufacturer specifications. The manufacturer normally provides its own form showing the QC checks it had performed prior to sending out the equipment. All checks and maintenance must be documented in the site logbook, DMDS, or any forms used as part of the check. The AMS parameter specialist is informed of any issues. Any impact to data will be determined on a case-by-case basis unless it is outlined in this QAPP or in the SOP “Gaseous Data Validation Using DMDS”. All procedures on how to do the diagnostic checks as well as identify any equipment deficiencies are outlined in the instrument’s manuals. In cases where equipment does not meet specifications, the AMB maintains enough spare units ready for use. Critical spare parts are also maintained to ensure data collection can continue. Critical spare parts may include items as part of routine checks, such as analyzer filters, or parts that may degrade over time, such as an ozone lamp.

**Table 13. Checks and Preventive Maintenance**

|  |  |  |
| --- | --- | --- |
| **Item** | **Inspection Frequency** | **Action Required** |
| Particulate filter | Every 3 to 4 weeks per AMS loop schedule | Change and document; all gases 5 micron pore size except CO and CO2 which are 0.5 |
| Analyzer diagnostics | Every 3 to 4 weeks per AMS loop schedule | Document flow, lamp intensities, etc. as per site visit template |
| Fan filter | Every 3 to 4 weeks per AMS loop schedule | If dirty, clean dust from fan filter and document |
| Span/QC cylinder | Every 3 to 4 weeks per AMS loop schedule; during QAS audit | Record cylinder pressure (should be greater than 200 psig) |
| Calibrator | Every 3 to 4 weeks per AMS loop schedule; during QAS audit | Record verification date; MFC’s due annually; O3 due 6 months |
| Zero air system | Every 3 to 4 weeks per AMS loop schedule; during QAS audit | Record maintenance date; due annually |
| Fittings and connections – all stainless steel or Teflon | As needed by AMS; during QAS audit | Visually inspect for any issues, e.g., loose connections, and document |
| Sample line - Teflon FEP or equivalent | As needed by AMS; during QAS audit | Replace line within 4 years of previous line change unless issues occur, then replace as soon as possible; document findings or if changed |
| Manifold and probe – borosilicate glass, Teflon, or equivalent | Every 3 to 4 weeks per AMS loop schedule; during QAS audit; vacuum check during QAS site evaluations | Document any issues, such as cracked, dirty, open port. Vacuum ≤ 1.0-inch water below ambient; AMS cleans annually unless dirt/dust is present, then it is cleaned as soon as possible |
| Residence time | AMS site setups; initial QAS site evaluation and then 2-year cycle afterwards, or if changes made at site that can impact time | Determine time; must be ≤20.0 seconds; failure will require action to be taken as soon as possible by AMS, such as reducing amount of sample line and increasing flows; Review of data to determine if a QA Qualifier or Null Data Qualifier is needed |

**Section 16: Instrument Calibration and Frequency**

All gas analyzers in the air monitoring network adhere to the prescribed calibration schedules that are defined in the sampling methods of 40 CFR Parts 50, 53, and 58, and the Quality Assurance Handbook for Measurement Systems Vol. II. SOPs generated by the AMB, such as those mentioned in section 6.2 of this QAPP, provide the specific details on the calibration procedures, time frames, and limits. All gas calibration results are used to calculate a slope and intercept and meet the limits as stated in section 7.1 of this QAPP. The slope and intercept are used with the analyzer response to calculate a concentration. The calculated slope and intercept are used until a new calibration is performed. Any maintenance which manipulates the data output of the analyzer will require a new calibration. A slope and intercept may be used with the analyzer response prior to a calibration if it is shown the analyzer was operating under stable, normal conditions (e.g., an adjustment is made to an ozone analyzer at noon, but the calibration is performed the following midnight; data collected from the time the analyzer shows stability up to the calibration may be calculated with the new slope and intercept). However, to ensure accuracy of the concentrations generated, the time frame of the slope and intercept being back calculated will be based on review of span, zero, One-Point QC, QA checks, trace review, operator logs, and any other information available. Data in question may be replaced with a Null Data Qualifier or be assigned a QA Qualifier.

Transfer standards used for this work also follow strict verification/certification/calibration schedules for valid data collection to occur. Almost all transfer standards are verified/certified/calibrated against standards that are maintained at the QA laboratory. If the QA laboratory cannot do the work, then the item is sent to a standards laboratory. On occasion some items are sent to a standards laboratory to cross check the transfer standards used in the QA laboratory. All equipment is verified/certified/calibrated prior to use. Any equipment used in the gases program to perform calibrations, spans, zeroes, QC checks, and audits will have documentation kept on it. A certification file will be kept for each item and stored in the QA laboratory and on the AMB shared drive. Table 14 lists the transfer standards used in the gases program. Table 15 lists specific O3 requirements, with additional information available in the AMB SOP “Ozone (O3) Transfer Standard Verification Procedures”. Work performed with an expired calibrator date is voided. Additional information on verified/certified/calibrated time frames is provided in the IDEM QAPP “Calibration, Certification, and Verification Methods of Transfer Standards”.

**Table 14. Instrument Calibration/Certification/Verification and Frequency**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Device** | **Frequency** | **Primary Standard** | **Limits / Comments** |
| Gas Calibrator MFC used for calibration, span, one-point QC, and zero checks | 12 months | QA laboratory Fluke Molbox1+ | ±2.0%; see AMB SOP “Calibration and Verification of Mass Flow Meters Using the Molbox™ and Molbloc-s™ System”. |
| Gas Calibrator O3 Photometer used for calibration, span, one-point QC, and zero air checks | 6 months | QA laboratory Level 2 – Indiana Primary Standard Photometer | See table 15. |
| Zero Air System used for CO, CO2, NO, NO2, NOy, O3, and SO2 zero air checks | 12 months; except 6 months for O3 calibrators that produce their own zero air | QA laboratory clean air system | See table 8, QAS zero air check. |
| 1 to 50 ppm SO2 in Nitrogen Gas Cylinder used for calibration, span, and one-point QC checks | 4 years | QA laboratory SRM, NTRM, or GMIS gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Sulfur Dioxide (SO2) Transfer Standard Certification and Verification”. |
| 1 ppm to 15% CO in Nitrogen Gas Cylinder used for calibration, span, and one-point QC checks | 8 years | QA laboratory SRM, NTRM, or GMIS gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Carbon Monoxide Transfer Standard Certification and Verification Procedures”. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Device** | **Frequency** | **Primary**  **Standard** | **Limits / Comments** |
| 0.5 to 50 ppm NO in Nitrogen Gas Cylinder used for calibration, span, and one-point QC checks | 3 years | QA laboratory SRM, NTRM, or GMIS Gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Nitric Oxide Transfer Standard Certification and Verification”. |
| 5 ppm to 20% CO2 in Nitrogen U.S. EPA Protocol Gas Cylinder used for calibration, span, one-point QC checks, and PE audits | 8 years | Cylinder Company SRM, NTRM, or GMIS Gas cylinder | Cylinder certified according to the 2012 U.S. EPA Traceability Protocol, Document #EPA-600/R-12/531, using Procedure G1. |
| Gas Calibrator MFC used for PE audits | 6 months | QA laboratory Cal Technix, Molbox | ±2.0%; see AMB SOP “Calibration and Verification of Mass Flow Meters Using the Molbox™ and Molbloc-s™ System”. |
| Gas Calibrator O3 Photometer used for PE audits | Quarterly | QA laboratory Level 2 – Indiana Primary Standard Photometer | See table 15. |
| 1 ppm to 15% CO in Nitrogen Gas Cylinder used for PE audits | 6 months | QA laboratory SRM, NTRM, or GMIS Gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Carbon Monoxide Transfer Standard Certification and Verification Procedures”. |

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of Device** | **Frequency** | **Primary Standard** | **Limits / Comments** |
| 500 ppb to 10% CO in Air Gas Cylinder used for PE audits | 8 years | QA laboratory SRM, NTRM, or GMIS gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Carbon Monoxide Transfer Standard Certification and Verification Procedures”. |
| 0.5 to 50 ppm NO in Nitrogen Gas Cylinder used for PE audits | 6 months | QA laboratory SRM, NTRM, or GMIS gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Nitric Oxide Transfer Standard Certification and Verification”. |
| 1 to 50 ppm SO2 in Nitrogen Gas Cylinder used for PE audits | 6 months | QA laboratory SRM, NTRM, or GMIS gas cylinder | All calculated concentrations must be ≤±4.0% of the average concentration. The difference between any two calculated concentrations must be ≤5.0%. QA verified concentration <±2.5% of manufacturer’s certified concentration; see AMB SOP “Sulfur Dioxide (SO2) Transfer Standard Certification and Verification”. |

**Table 15: Ozone Certification Requirements**

|  |  |  |
| --- | --- | --- |
| **Criteria** | **Limit** | **Comment** |
| 1-day Slope | 0.975 to 1.025 (or  ±2.5% of 1.000) | NA |
| 1-day Intercept | ±5 ppb (+0.005 ppm). | NA |
| Std Dev (Sm) of Average Slope (expressed as a percentage) | Sm ≤ 3.7% | The standard deviation of the average of 6 slopes. Calculated from either the initial 6-day certification or the 1-day recertification. |
| **Criteria** | **Limit** | **Comment** |
| Std Dev (SI) of  Average Intercept (expressed as a percentage) | (SI) ≤ 1.5% | The standard deviation of the average of 6 intercepts. Calculated from either the initial 6-day certification or the 1-day recertification. |
| Slope of 1-day recertification (m) | M ±5% | 1-day recertification slope must be ≤±5.0% of the average slope of the current 6-day certification. |

**Section 17: Inspection/Acceptance Requirements for Supplies and Consumables**

Analyzer and calibrator replacement parts are obtained from the manufacturer or a distributor when the items are needed by the AMB. The parameter specialist for the AMS and the ATS keeps track of their own supplies and will order items when needed. The QA laboratory manager makes sure the QA laboratory has enough supplies and QA field staff also keep track of when items are needed. A designated QA environmental manager will order supplies for the QAS when needed. Most consumables for gas analyzers do not have an expiration date. If there is an expiration date the AMS and ATS parameters specialist and the QA laboratory manager will track and dispose of it when it expires. Certified gas cylinders are purchased from cylinder manufacturers for the AMS and the QAS by a designated AMS environmental manager when needed, with spares available for use between orders. Gas cylinders are verified by the QA laboratory, except CO2 cylinders, which are NIST-traceable manufacturer certified, and tracked by both the AMS and QAS. Paperwork is kept with the cylinders which shows when the cylinder manufacturer certification expires and the QA Laboratory verification. The cylinder documentation is kept in the QA laboratory and managed by the QA laboratory manager.

**Section 18: Non-direct Measurements**

IDEM uses all of its own certified data to determine design values and if an area meets the NAAQS (see [40 CFR Part 50](https://www.ecfr.gov/cgi-bin/text-idx?SID=a1532df110031686f2b271bd5f7fddee&mc=true&node=pt40.2.50&rgn=div5)). However, non-direct measurement data will be used to support data validation activities. Such data may include historical data or reported concentrations and meteorological measurements from other entities, such as industries and the National Weather Service. Traffic counts from INDOT may also be used (e.g., determine distance air monitoring site must be away from a road). Census population data may be used to determine the appropriate number of samplers/analyzers for an urban area. Data acquired from non-direct measurements may also include site operator observations. The additional data used for site selection and data analysis are viewed as being accurate since this data falls under specific rules and guidelines.

**Section 19: Data Management**

Minimizing data loss is of paramount importance to a monitoring program to meet and exceed the program’s data completeness requirements. Data loss can result from missing or invalid data or a delay in restarting data collection due to equipment being down. Data records are generated using the DMDS. It is the goal of IDEM to collect 100% of generated data and maintain a completeness rate of at least 75% valid data. The U.S. EPA requires at least 75% of data to be valid to meet completeness requirements. The processes of determining valid data and the QC/QA of these processes are mentioned in this QAPP and SOPs.



The data process includes collecting, storing, transmitting, verifying, validating, and reporting to the U.S. EPA’s AQS database.

The data process starting from the field to AQS submittal consists of the following steps below.

1. Data collection is performed using an approved U.S. EPA reference analyzer.
2. Data is sent from the analyzer digitally to the on-site data logger. Although data collection is continuous, data is averaged in five-minute intervals. The data logger can store up to approximately two weeks of data before it starts being overwritten. The data logger at the site requires a password to access it.
3. The DMDS communicates with the data loggers and retrieves data every 15 minutes through a cellular modem. The DMDS software collects data from the data logger using the Native Datalogger Computer-To-Computer language (CC-SAIL). Preliminary data checks are performed automatically before data is stored on the DMDS server.
4. The data is decoded, checked for errors, processed, and stored in a database. The DMDS server has a mirror backed for disaster recovery. The raw data can also be reloaded if needed, such as accidental deletion of processed numbers or erroneous slope, intercept, offset applied to data.
5. The DMDS software performs quality control checks on the span/zero checks (SZ), span/1-point QC/zero checks (SPAN) and calibrations (CAL) to determine if they meet tolerance limits. The results of the automatic quality checks can result in data flagging, affecting data validity.
6. Each business day, the AMS DMDS Administrator will check the monitoring data database to ensure that all data were polled and transmitted successfully from each monitoring station and stored on DMDS. In case of missing data, a re-poll can be initiated to backfill the data.
7. Approximately one to four weeks after the end of a month, AMS staff will initiate the data verification procedure. AMS staff review and flag raw data and document data verification within the DMDS. The DMDS requires a log entry when any changes are made to the data. The logs document who verified the data, changes made, and a date/time when this occurred (see AMB SOP “Gaseous Data Validation Using DMDS”).
8. Once the data has been verified, AMS staff will inform the QAS program coordinator via e-mail that verified data is ready for validation.
9. The QAS program coordinator logs the date that the verified data has been sent to the QAS and then informs QAS environmental manager via e-mail that data is ready for validation. The QAS environmental manager has 15 working days to complete the validation process. Any exceedance review is performed within 15 working days after the validation process is completed.
10. The QAS environmental manager logs into the DMDS server (read access only) and performs an audit on the data (validation process) using the various DMDS reports. The validation process is documented on a Validation Check form, which is stored on the Branch shared drive.
11. If data issues arise during the validation process, the issues are sent to the appropriate AMS staff member for correction or additional information.
12. Once the validation review is complete, the QAS environmental manager will electronically initial and date the Validation Check form. The QAS environmental manager informs the QAS program coordinator via e-mail that the data validation is complete.
13. The QAS program coordinator will log the data validation completion date and inform the AMS AQS administrator via email that the data review process is completed by the QAS.
14. The AMS AQS administrator downloads the validated data from the DMDS and submits the data to AQS.
15. Once all data for a quarter have been verified and validated, a designated environmental manager in the AMS submits one-point quality control checks and a designated QAS environmental manager submits QA PE audits into AQS.
16. Each quarter AMP reports (251, 256, 450) are submitted by a QAS environmental manager to the QAS chief, and these are reviewed for accuracy and any issues. Any indication of a problem will require further analysis by QAS and/or AMS of the reported data with the possibility of data resubmission.
17. Each year data from the previous year is certified as being true and accurate. The AMB chief, AMS (1 and 2) chiefs, ATS chief, QAS chief, and specific staff in the AMS (1 and 2) and QAS do a final check on this data package, which is then submitted to U.S. EPA.

Annually, the AMS will verify each data logger’s channel voltage input against an NIST certified power supply. For sites which use digital, 25% of those sites have the raw data from the data logger compared with the five minute and hourly analog values downloaded from the analyzer. Both procedures help ensure an accurate collection of data by testing the acceptability of the hardware and software configurations.

Quarterly verified and validated data are submitted to the AQS within 90 days after the quarter is complete. Data consists of ambient concentrations, one-point QC checks, and PE audits. Ambient data are made available to the IDEM website as it is being collected; therefore, the data have not initially had QC or QA checks performed. Data are also provided to AIRNOW (<https://www.airnow.gov/>) as it is being collected.

Data generated by the QAS during PE audits or manual One-Point QC checks is entered into an audit spreadsheet form; that file is saved as a portable document format (pdf) file and then stored to the AMB shared computer drive. In addition, the audit data is entered into the U.S. EPA QA Transaction Generator to create a text file, which is submitted to AQS quarterly.

**Section 20: Assessments and Response Actions**

Every monitoring project includes periodic assessments to provide continuing verification that the project is being performed according to the procedures developed in the QAPP, and that the data obtained meet the measurement quality and overall monitoring project objectives. This section details the assessments that will be performed, the personnel responsible, the frequency and the reports produced, as well as corrective actions taken based on the results of each assessment. IDEM utilizes several assessment procedures to identify and correct issues. The corrective action process must either include formal communications (e.g., official memoranda) or informal communications (e.g., e-mail messaging) and with responses provided as formal or informal communications. Verbal communication can be used to initiate the corrective action or acknowledge completion of the corrective action but must be followed up with written communication for documentation purposes (see table 16 for a list of assessments). In any situation, it is the AMB goal to continue to collect valid data; however, there could be some instances where outside factors jeopardize the project, resulting in some data not being collected. The AMB does what it can to maintain continuous data collection as stated in this QAPP and will look for any possible solution to resolve issues.

**Table 16. Assessments and Response Actions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assessment** | **Conducted By** | **Frequency** | | **Requirement** |
| Zero/Span | AMS | Daily or weekly | | QAPP |
| One-Point QC | AMS | Weekly | | QAPP |
| PE Audit | QAS | 6 months | | QAPP |
| Data Verification | AMS | Monthly | | Screening of data, chart trace, QC checks |
| Data Validation | QAS | Monthly | | Screening of data, chart trace, QC and QA checks |
| High Value Event | QAS | As needed | | Screening of information, such as calibration, zero, span, one-point QC, chart trace, etc. which may confirm the high value |
| Ambient Air Protocol Gas Verification Program | U.S. EPA | CO, NO, and SO2 cylinders sent on a 3-year cycle | | U.S EPA Program |
| AMP Reports – 251, 256, 430 | QAS | Quarterly | | Review data for statistical issues and completeness |
| **Assessment** | **Conducted By** | | **Frequency** | **Requirement** |
| QAPP | QAS | | Annually | Determine if changes are needed which accurately describes the project |
| ANP | AMB | | Annually | 40 CFR § 58.10 |
| Annual Data Certification | AMB | | Annually | 40 CFR § 58.15 |
| Siting | QAS | | 2 years per site | QAPP |
| 5 Year Network Assessment | AMB | | 5 years | 40 CFR § 58.10 |
| NPAP | U.S. EPA Regional Personnel/Contractor | | See Section 7.2 of this QAPP | Section 7.2 of this QAPP |
| Technical Systems Audit | U.S. EPA Regional Personnel | | 3 years | 40 CFR 58  Appendix A § 2.5 |

If an assessment identifies an area of concern, there are specific corrective actions which occur depending on what the finding shows. Below is listed the assessment and corrective action time frame for follow-up.

Zero/Span – Every business day, the AMS DMDS Administrator reviews the daily span/zero checks for possible issues (e.g., zero/span checks not occurring). The appropriate AMS parameter specialist also has the responsibility to review the daily checks for span/drift issues. The appropriate AMS staff member addresses the issue once they are aware. QAS environmental manager verifies that action was taken, and the issue resolved during the data validation process.

One-Point QC – Every business day, the AMS DMDS Administrator reviews any scheduled span/1-point QC check/zero checks for possible issues. The appropriate AMS parameter specialist has the responsibility to review the weekly checks for issues. The appropriate AMS staff member addresses issues once they are aware. QAS environmental manager verifies that action was taken, and the issue resolved during the data validation procedure.

PE Audit – The QAS is set up as an independent section within the AMB and as such performs internal PE audits using equipment (gas calibrators, zero air generators, and compressed gas cylinders) that are independent of calibration, span, and one-point quality control point equipment used by the AMS. PE audits are scheduled by a QAS environmental manager monthly. QAS staff members notify the AMS parameter specialist of any issues either from site or once back in the office with written notification (memorandum or e-mail) following soon after. Once the issue is resolved, the AMS parameter specialist must document the issue resolution.

Data Verification Process – The AMS parameter specialist performs a verification of the ambient data within 1 to 3 weeks after the end of a month. Documentation of the process can be found in the DMDS annotation logs.

Data Validation Process – A QAS staff member performs a validation review of the data within 15 working days after the QA Program Coordinator is informed that a data package is available for review. Data validation is documented on the Validation Check form, which are stored on the AMB shared drive.

High Value Event – A QAS staff member performs additional reviews on any high values which meet or exceed the NAAQS for that parameter. This review is performed within 15 working days after the data validation is completed for that specific site and month. The high value event is documented on a data sheet, which is stored on the AMB shared drive.

Ambient Air Protocol Gas Verification Program – Corrective action taken immediately by QAS for any actions identified by the Ambient Air Protocol Gas Verification Program.

AMP Reports – Quarterly AMP Reports (AMP251, AMP256, AMP430) are sent to the QAS chief after the 1-point QC checks and PE audit results are submitted to AQS within 90 days after the end of the quarter. The QAS chief and an environmental manager may consult with AMS to resolve any issues once any are discovered. If practical, the issue should be resolved within two weeks after identification of the issue.

QAPP – QAS section chief ensures QAPP is being followed and makes necessary changes, with approval by AMB chief, AMS (1 and 2) chiefs, and ATS chief. An annual check is documented or when a change needs to be made in the QAPP revision history.

ANP – The Annual Network Plan is due to the U.S. EPA Regional Administrator by July 1st. The AMB tries to have a complete ANP available for public comment by mid-May to allow for the 30-day public comment period to be completed by mid-June. Corrective actions taken immediately (based on issue could be one day but prior to New Year) by AMB based on U.S. EPA feedback.

Annual Data Certification – The Annual Data Certification for ambient data from the previous year (January 1 – December 31) is due to the U.S. EPA Regional Administrator by May 1st of each year. The AMB reviews the annual data package and resolves any correctable issues, if practical, prior to submission of the certification package.

Siting – The QAS performs site evaluations on a 2-year cycle from the previous site evaluation. The AMS addresses issues based on QAS findings (usually within one workday if data is impacted or some time frames may be extended based on the nature of the issue and if the site is on private property). QAS chief ensures corrective action is taken to resolve the issues.

5 Year Network Assessment – The 5-year Network Assessment is due at U.S. EPA by July 1st for years ending in zero or five. Corrective actions by AMB based on U.S. EPA feedback within the time frame allotted for the response.

NPAP – QAS chief works with AMS to address failing NPAP results issues as soon as possible (usually within a week to resolve any issues).

Technical Systems Audit – Technical System Audits are scheduled by the U.S. EPA Regions on a 3-year frequency. The QAS works with AMS(s) and ATS to address any audit findings. All findings should be resolved within 1 year of the TSA report.

**Section 21: Reports to Management**

Reports that are generated and utilized in the gases program are listed in Table 17.

**Table 17. Reports to Management**

|  |  |  |
| --- | --- | --- |
| **Report** | **Frequency** | **Responsible Party** |
| Daily O3 Update | As needed for high O3 values | AMS |
| O3 Exceedance Report | Monthly | AMS |
| AMP Reports | Quarterly | QAS |
| CO, NO2, O3, SO2 Exceedance Reports | As needed | QAS |
| Invalid Data Memos | As needed | AMB |
| Annual Network Plan | Annual | AMB |
| 5 Year Network Plan | 5 Years | AMB |

**Section 22: Data Validation and Usability**

Many of the criteria used to review and validate data have been detailed in the previous sections of this QAPP. The AMB utilizes this established QAPP, SOPs listed in this QAPP, and U.S. EPA Validation Template found Appendix D of “[Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program](https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/APP_D%20validation%20template%20version%2003_2017_for%20AMTIC%20Rev_1.pdf)", to determine data validity. Once data has gone through all the processes, then it is deemed usable for its intended objective.

**Section 23: Validation and Verification Methods**

Data verification is the process of evaluating the completeness, correctness, and conformance of a specific data set against the method, procedural or contractual requirements, as specified in both the SOPs and [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5). Data validation is a process that extends the evaluation of data beyond method, procedural or contractual compliance (i.e., data verification) to ensure that reported values meet the quality goals of the environmental data operations and that the data can be used for its intended purpose.

The AMB uses the criteria gas pollutant validation templates provided in Appendix D of the U.S. EPA QA Handbook for Air Pollution Measurement Systems: Volume II: Ambient Air Quality Monitoring Program (EPA-454/B-17-001, January 2017) for the weight of evidence approach for validating criteria gas data. The AMB follows the guidance in the QA Handbook regarding the use of these templates and handles the criteria as follows:

* Critical criteria are issues deemed critical to maintaining the integrity of the hourly ambient concentration measurement or a group of successive hourly ambient concentration measurements. Data reviewers should invalidate observations that do not meet each criterion in the critical criteria table unless there are compelling reasons and justification for not doing so. The hourly measurement or group of hourly measurements that do not meet one or more of these criteria is invalid unless proven otherwise. In most cases, the CFR dictates the requirement, the implementation frequency of the criteria and the acceptance criteria so these criteria are considered regulatory in nature.
* Operational criteria are situations where violations of a criterion or criteria may be cause for invalidation of the data. Data reviewers should consider other QC information that may or may not indicate the data are acceptable for the parameter they want to control. Therefore, ambient data, which do not meet one or more of these criteria, are suspect unless other QC information demonstrates otherwise, and the reviewers have adequate documentation of that information. Data reviewers should investigate, mitigate, or justify the reason for not meeting the criteria.
* Systematic criteria include those criteria, including the DQOs, which are important for the correct interpretation of the data, but do not usually impact the validity of the ambient data. If the data do not meet the DQOs, this does not invalidate any of the hourly measurements, but it may impact the confidence in the attainment/non-attainment decision.

The AMB brackets all gas concentration data using the results of the one-point QC checks, calibration, or performance evaluation audit to ensure the gas analyzers were in proper operating condition between the checks. When a monitor fails a check, the DMDS software automatically flags the data from the last passing 1-point-QC check to time & date when the issue causing failure is remedied. The AMS parameter specialist will review the data, determine the cause for the failure and verify the extent of the data invalidation period. During the validation process, the QAS will review the invalid data period to ensure it is proper, accurate, and documented.

**23.1 DMDS Data Review**

As data are being collected in the DMDS, there are several automatic checks that the DMDS software performs, such as a calibration, span, zero, one-point QC checks, and stability issues. Dramatic shifts in data can also be recognized by DMDS, which will then flag the data until the AMS parameter specialist can do a further review. The DMDS software acquires 5-minutes concentration averages from the instantaneous concentrations generated by the gas analyzers. The DMDS applies a series of automatic tests to check the validity of calibrations, span/1-point QC checks/zero, and span/zero checks. Depending on the outcome of the automatic tests, DMDS may initially flag the check as PASSED, WARNING, or FAILED (See DMDS Manual for information on the types of automatic tests and the check results). A FAILED check will result in flagging affected data with a DMDS out of limits null code. Missing data is flagged within the DMDS system, but the appropriate null code (reason for the missing data) must be manually added by the parameter specialist.

**23.2 AMS Verification**

The DMDS administrator reviews the DMDS reports every business day to check for anomalies and to repoll data loggers when missing data is noted. In addition, the DMDS administrator will review any failed check and notify the AMS parameter specialist of the issue. The DMDS administrator will review the hourly values for any high values (potential NAAQS exceedance) and notify the AMS parameter specialist and the QAS.

After a month of data is collected, a monthly pollutant concentration report is generated by DMDS. The AMS verifies all data per the AMB SOP “Gaseous Data Validation Using DMDS” during the monthly data review. The monthly report is reviewed by the AMS parameter specialist for data values as well as any flags applied by DMDS. These are reviewed using the DMDS operator log to justify the application of the flag and to determine if they are accurately applied. The data trace is also evaluated. Any changes needed are applied by the AMS parameter specialist. Once this process is completed the AMS parameter specialist leaves an annotation note in DMDS, which means the data have been verified. Once the verification process is completed by the AMS, the QAS program coordinator is informed by the AMS parameter specialist that the data are ready for validation.

A list of null and data qualifiers commonly used to flag data as appropriate are provided in Table 18. The DMDS automatically applies a data qualifier to most data when needed. The data qualifier can be changed by the parameter specialists during the verification process.

**Table 18. Null and Data Qualifiers**

|  |  |  |
| --- | --- | --- |
| **[Description](http://idem.tx.sutron.local/cgi-bin/view_qualifier_definitions.pl?sort_order=description)** | [**EPA Qualifier**](http://idem.tx.sutron.local/cgi-bin/view_qualifier_definitions.pl?sort_order=qualifier) | |
| **Null Data** | **Data Qualifier** |
| Deviation from a CFR/Critical Criteria Requirement |  | 1 |
| Data reviewed and validated |  | 1V |
| Operational Deviation |  | 2 |
| Field Issue |  | 3 |
| Lab Issue |  | 4 |
| Outlier |  | 5 |
| QAPP Issue |  | 6 |
| Below Lowest Calibration Level |  | 7 |
| Neg Value Detected - Zero Reported |  | 9 |
| High Winds |  | IJ |
| Stratospheric Ozone Intrusion |  | IO |
| Volcanic Eruption |  | IS |
| Structural Fire |  | IP |
| Chemical Spill or Industrial Accident |  | IC |
| Unusual Traffic Congestion |  | IR |
| Construction/Demolition |  | J |
| Infrequent Large Gatherings |  | IK |
| Shelter Temperature Outside Limits | AE |  |
| Insufficient Data (cannot calculate) | AI |  |
| Voided by Operator | AL |  |
| [**Description**](http://idem.tx.sutron.local/cgi-bin/view_qualifier_definitions.pl?sort_order=description) | [**EPA Qualifier**](http://idem.tx.sutron.local/cgi-bin/view_qualifier_definitions.pl?sort_order=qualifier) | |
| **Null Data** | **Data Qualifier** |
| Machine Malfunction | AN |  |
| Bad Weather | AO |  |
| Collection Error | AQ |  |
| Poor Quality Assurance Results | AS |  |
| Calibration | AT |  |
| Monitoring Waived | AU |  |
| Power Failure | AV |  |
| QC Control Points (zero/span) | AY |  |
| QC Audit | AZ |  |
| Maintenance/Routine Repairs | BA |  |
| Multi-Point Calibration | BC |  |
| Precision/Zero/Span | BF |  |
| Operator Error | BJ |  |
| Site computer/data logger down | BK |  |
| QA Audit | BL |  |
| Sample Value Below Acceptable Range | BR |  |
| Exceeds Critical Criteria | EC |  |
| Estimated; Exceeds Upper Range |  | EH |
| Fire – Canadian |  | IF |
| Fireworks |  | IH |
| Prescribed Fire |  | IM |
| Wildfire – U.S. |  | IT |
| Value less than MDL |  | MD |
| Fireworks |  | RH |

Additional qualifiers are available to be applied. These can be found at <https://aqs.epa.gov/aqsweb/documents/codetables/qualifiers.html>.

**23.3 QAS Validation**

The QAS validates the data per the following AMB SOP “Data Management and Display System (DMDS) Validated Data Review Procedures”. The QAS program coordinator sends an e-mail to the QAS staff member who is responsible for performing the validation on that specific parameter. A standard validation check form is used by QAS, which includes analysis of concentrations as well as a review of QC and QA processes and to document the review.

When high concentrations are identified whether by email or memo by the AMS, the QAS is notified of the site and date/time when the high event occurred. In some instances, a high concentration could be discovered during the data audit process. In either situation, the QAS will initiate a NAAQS high event memorandum. A standard form is used to identify if the data exceeding the NAAQS is of a valid nature. The high event verification form identifies results of specific checks preceding and after the exceedance event. If a check on both sides of the NAAQS high event is considered valid, then that data is considered valid provided that no intervening null codes between the checks invalidates the data. If any checks indicate an issue, the data may be suspect. The gas checks may be quarterly QAS PE audits or AMS zero, span, and QC one-point checks. In some situations, this may entail a special QA audit after the exceedance to verify analyzer performance and data validity. Any invalid or missing data may be documented in the comments portion of the exceedance form.

Once data validation is completed by the QAS, the QAS program coordinator informs the AMS AQS administrator that the data validation is complete. The AMS AQS administrator then loads the data into AQS.

The QAS chief and a QAS environmental manager reviews various AMP reports, such as AMP251, AMP256, and AMP350 that are generated quarterly from AQS and reviewed for any data that requires further analysis. The QAS has the authority to have data rechecked and if needed, invalidate additional data.

**Section 24: Reconciliation with Data Quality Objectives**

The data quality objectives and intended uses for the gas pollutant data are discussed in Section 7 of this QAPP. The main purpose of this data is to show compliance with the U.S. EPA NAAQS and to measure air pollutant concentrations that may be of concern for public health concerns and public welfare considerations. Section 7 of this QAPP also lists the measurement quality objectives, which were established to provide the expected data quality that users need.

It is the role of the QAPP to establish procedures to control measurement uncertainty to an appropriate level to achieve the objectives for which monitoring data are collected. If guidelines and any SOPs governing the measurement process are followed and all measurement quality objectives listed in this QAPP are met, it will be recognized that the DQOs can be achieved. However, there is always a chance that exceptional field events may negatively affect the performance of the monitoring station. Therefore, it is important to reconcile the monitoring data with the DQOs to evaluate whether the data set is adequate for its intended use. This involves reviewing routine data, such as the monthly verification and validation reviews described in section 23 of this QAPP, and the results of 1-point quality control checks.

On a quarterly basis, the performance of the monitoring network will be evaluated by reviewing the data quality statistics (precision, bias, and completeness) of the QA/QC data set and comparing the results to the monitoring project goals. Data quality assessment statistics are taken from the AQS AMP450 Report, Quick-look Report, the AQS AMP430 Report, Data Completeness, and the AQS AMP256 Report, QA Data Quality Indicator Report. The AMP450 Report provides summary statistics on the criteria pollutant data collected. The AMP430 Report provides a status of the quantity of criteria pollutant collected. The AMP256 Report provides a status of the QA/QC activities (precision and bias statistics). Unacceptable performance for any of the DQO goals does not automatically indicate that the data set cannot be used for its intended purpose, i.e., the support of the decision process for a NAAQS. However, the impact on the confidence with which the data set can be used for its intended purpose in the decision process will have to be reviewed and communicated. This is done in the quarterly reports generated by the QAS environmental manager and QAS chief. Any anomalies are reported to the AMS(s) and ATS section chiefs and the AMB chief. The reports will identify the point(s) the data failed to meet DQOs and at what point in time, after corrective action, the data again meets DQOs. The corresponding data will be flagged and commented, and all supporting documentation will be included in the report. Data may be required to go back through the data validation process and have some approval from the QAS chief. The QAS chief will make sure data in AQS has been accurately changed.

The performance of the monitoring network for the previous year’s data (January 1 to December 31) is evaluated for the annual Data Certification Package, which is due to the U.S. EPA by May 1st. The AQS AMP600 Report, Certification Report, is used to evaluate the performance of the network as to it attaining the Data Quality Objectives. The AMP600 report provides summary statistics on QA/QC activities (precision and bias statistics) and on collected data from each monitor. This report also provides a summary evaluation of monitoring network performance by flagging data collection and QA/QC activities as acceptable (green), warning (yellow) or recommend N (red). Normally by this time any issues or concerns have already been addressed and sufficient documentation is available. The annual certification letter will provide a short summary to document data collection or QA/QC activities flagged as warning (yellow) or red (recommend N).

**Section 25: References**

(1) EPA QA/R-5 (March 2001), Requirements for Quality Assurance Project Plans, U.S. Environmental Protection Agency, Washington, DC.

(2) EPA-454/B-18-006 (August 2018), Guide to Writing Quality Assurance Project Plans for Ambient Air Monitoring Networks, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC

(3) EPA-454/B-17-001 (January 2017), Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC

(4) EPA QA/G-8 (November 2002), Guidance on Environmental Data Verification and Data Validation. U.S. Environmental Protection Agency, Washington, DC.

(5) Wright, B. EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (2012 Revision). U.S. Environmental Protection Agency, Cincinnati, OH, EPA/600/R/12/531 (2012).

(6) EPA (04/07/2011), Quality Assurance Guidance Document - Field Standard Operating Procedures for the EPA Through-the-Probe National Performance Audit Program (NPAP Field SOP, Sections 0-11), Accessed at https://www3.epa.gov/ttn/amtic/npapsop.html (December 2019).

(7) EPA Ambient Air Protocol Gas Verification Program, Implementation Plan, AA-PGVP Implementation Plan 4/2010, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC

(8) [40 CFR Part 50](https://www.ecfr.gov/cgi-bin/text-idx?SID=a1532df110031686f2b271bd5f7fddee&mc=true&node=pt40.2.50&rgn=div5)

(9) [40 CFR Part 53](https://www.ecfr.gov/cgi-bin/text-idx?SID=aebf303cc012de856ea499a901acc586&mc=true&node=pt40.6.53&rgn=div5)

(10) [40 CFR Part 58](https://www.ecfr.gov/cgi-bin/text-idx?SID=d99bbcf91c47433513a6bb57745130e3&mc=true&node=pt40.6.58&rgn=div5)

(11) QAPP: Calibration, Certification, and Verification Methods of Transfer Standards, Volume V (2022)