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Office of Air and Radiation (OAR)
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Air Quality Assessment Division
Air Monitoring Technology Branch

STANDARD OPERATING PROCEDURE (SOP)

SOP Title: Standard Operating Procedure for Performing Flow-Based Audits in the National Performance Audit Program

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Revision History

Revision No.	Author	Date of Revision	Description of Change(s)
0	Brannon Seay	2025-11-26	Initial Draft

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SOP Title: *Standard Operating Procedure for Performing Flow-Based Audits in the National Performance Audit Program*

1. Scope and Applicability

The purpose of this Standard Operating Procedure (SOP) is to detail and standardize the methods and procedures performed by field scientists (FSs) and Environmental Protection Agency (EPA) Regional National Performance Audit Program (NPAP) Leads for conducting through-the-probe (TTP) gas **flow-based audits (FBAs)** of criteria pollutant gases including carbon monoxide (CO), sulfur dioxide (SO_2), and oxides of nitrogen (NOx) under the NPAP. This SOP is a resource for training new FSs and as an in-field reference for experienced FSs. This SOP also serves as a reference for self-implementing Primary Quality Assurance Organization (PQAO) TTP audit programs performing FBAs.

The FBA process is only applicable to audit SO_2 and CO instruments, and nitric oxide (NO)/NO_2/NOx instruments that include an NO measurement channel. The process is not currently applicable for direct-read NO_2-only instruments without an NO channel. Ozone (O_3) audits cannot be performed by the FBA method and still require an O_3 analyzer and standardization by the measurement verification audit (MVA), in addition to a current ozone line loss test.

The FBA method is an alternative to the established MVA, which had been the standard and previously only approved method for performing NPAP audits. An SOP for conducting MVAs, *Standard Operating Procedure (SOP) for the Through-the-Probe (TTP) National Performance Audit Program (NPAP) Version 2.0, January 2022* (NPAP MVA SOP), is available on EPA's Ambient Monitoring Technology Information Center (AMTIC)[1]. Note, the NPAP MVA SOP also includes limited and now antiquated details on conducting FBAs. Staff performing NPAP audits should not reference the NPAP MVA SOP for conducting FBAs and must only follow procedures described within this SOP.

Due to variability in equipment inventories among the EPA Regional Offices, procedures described in this SOP are agnostic to instrument manufacturer and model but are common to the specific instrument purpose (e.g., gas calibrator). Deviations (whether already occurred or planned) from the procedures in this document can compromise the goals and integrity of the NPAP. Deviations, when planned or unplanned, are to be reported in writing and submitted to the appropriate EPA Regional NPAP Lead and to the Office of Air Quality and Planning and Standards (OAQPS) NPAP Lead. Potential modifications to this SOP shall be proposed in writing to the OAQPS NPAP Lead who will consider the modifications for the next revision.

This document follows the format for technical SOPs outlined in EPA's *Guidance for Preparing Standard Operating Procedures (SOPs), EPA QA/G-6, EPA/600B-07/001, April 2007*.

[1] As of the publication of this SOP, the NPAP MVA SOP is accessible on AMTIC: https://www.epa.gov/system/files/documents/2023-08/NPAP%20SOP%20Revision%202%20March%202023_508.pdf.

2. Summary of Method

The FBA process involves employing dynamic flow dilution of a standard gas (via a multiblend gas cylinder) and diluent gas (via a zero air generator [ZAG]) using a gas dilution calibrator. Significant to FBAs, the calibrator's standard and diluent gas flow rates, which are controlled by internal mass flow controllers (MFCs), are standardized using two or three flow rate transfer standards. The standardized flow rates and certified standard gas concentrations are then used to calculate the audit challenge gas concentrations. The established MVA process also uses dynamic dilution, but instead of standardizing the dilutions system flows, the gas concentration after dilution is standardized by measurement with a CO analyzer. Advantages of FBAs as compared to MVAs include:

1. **Less equipment needs**: FBAs do not require a CO analyzer, High CO gas cylinder, or Low CO gas cylinder. FBAs do employ two or three flow rate transfer standards that are not needed for MVAs, although these devices are relatively inexpensive and small, minimally adding to transportation burden. Transporting less bulky equipment is even more advantageous when conducting audits at monitoring stations with limited access (e.g., require sea or air travel, located in remote areas where special vehicles are required, etc.).
2. **Reduced uncertainty at low challenge concentrations**: Eliminates uncertainty in low-level CO, SO_2, and NOx measurements attributable to CO analyzer zero drift, which may be as much as 0.040 parts per million (ppm) over the course of one audit event.
3. **Faster audits**: Given no CO analyzer is employed with FBAs, the time needed to conduct audits is reduced. The following time-consuming steps are not needed when conducting FBAs:
    a. Long CO analyzer warm-up time (minimally 3.5 hours and recommended over 48 hours) necessary to minimize zero drift.
    b. NPAP CO analyzer stability wait time at each audit level (still must wait for the station analyzer to stabilize).
    c. CO analyzer pre- and post-audit calibration/verification.

The high-level steps to conducting an FBA include:

1. Determine the challenge concentrations and associated standard and diluent flow rates needed to achieve these concentrations.
2. Program and operate the gas calibrator at the derived standard and diluent flow rates.
3. Measure the standard and diluent flow rates using calibrated flow rate transfer standards during each audit point (i.e., as the challenge gas is delivered to the monitoring station inlet).
4. Calculate the final challenge gas concentrations provided the 1-minute averaged measured standard and diluent flows, and the certified multiblend standard gas cylinder concentrations.
    a. Measured flows and cylinder concentrations are entered into a protected Microsoft Excel calculation worksheet, herein referred to as the FBA Workbook, which automatically calculates the final challenge concentrations. This worksheet file is access-controlled and maintained/updated by the OAQPS NPAP Lead. The current version of the FBA Workbook is available on the NPAP Microsoft Teams Channel.
5. Compare the station and NPAP concentrations and prepare/distribute an audit report that summarizes the results to the station operator.

At the time of this SOP's release, the NPAP audit software *Performance Evaluation Audit Tool* (PEAT) was not configured to process FBAs. It is planned that future PEAT revisions will include updates to accommodate FBAs. This SOP will be revised once these revisions are in place. Until then, the FBA Workbook is the only EPA approved software for conducting FBAs. No other unprotected/uncontrolled software/spreadsheet is to be used to conduct FBAs.

3. Definitions/Acronyms

Table 3-1. Acronyms and Abbreviations

Abbreviation	Definition
AA-PGVP	Ambient Air Protocol Gas Verification Program
AC	alternating current
AMTIC	Ambient Monitoring Technology Information Center
AQS	Air Quality System
BOA	back-of-analyzer
CCM	cubic centimeters per minute
CO	carbon monoxide
COA	certification of analysis
DAS	data acquisition system
EPA	Environmental Protection Agency
FBA	flow-based audit
FBA Workbook	The protected Microsoft Excel calculation worksheet used to perform FBAs in the NPAP
FIPS	Federal Information Processing Standards
FS	field scientist
ft	feet
g	grams
GPT	gas-phase titration
I.D.	inner diameter
LPM	liters per minute
MFC	mass flow controller
mmHg	millimeters of mercury
MVA	measurement verification audit
NIST	National Institute of Standards and Technology
NO	nitric oxide
NOx	oxides of nitrogen
NO_2	nitrogen dioxide
NPAP	National Performance Audit Program
NPAP MVA SOP	Standard Operating Procedure (SOP) for the Through-the-Probe (TTP) National Performance Audit Program (NPAP) Version 2.0, January, 2022

Abbreviation	Definition
NPT	national pipe thread
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
O.D.	outer diameter
O_3	ozone
PC	personal computer
Pd	palladium
PEAT	Performance Evaluation Audit Tool
PN	part number
ppb	parts per billion
ppm	parts per million
PQAO	Primary Quality Assurance Organization
psig	pounds per square inch
PTFE	polytetrafluoroethylene
QAPP	Quality Assurance Project Plan
SCCM	standard cubic centimeters per minute
SOP	Standard Operating Procedure
SO_2	sulfur dioxide
SRP	standard reference photometer
TTP	through-the-probe
ZAG	zero air generator
°C	degrees Celsius

4. Health and Safety Warnings

The CO concentration in the multiblend cylinder can potentially create dangerous conditions for FSs when conducting audits. A household CO detector is required for all audit configurations (whether a mobile laboratory or case-based configuration). The CO detector must be tested to ensure proper operation before each audit and when changing regulators on a cylinder and/or manipulating plumbing. When potentially venting standard gas containing CO, ensure that these activities are conducted in a well-ventilated area. Cylinder regulators must always be purged in a well-ventilated area with a vent line (>10 feet [ft] in length) so that the vented gas is a safe distance away from people and animals.

FSs and staff handling compressed gases must be aware of the hazards in handling compressed gas cylinders and will employ safe practices. High pressure cylinders must be properly secured within vehicles and trailers and must have clamshell-type valve protectors installed and secured prior to transporting cylinders.

To prevent personal injury, personnel must heed warnings associated with the transport and operation of NPAP equipment and vehicles (trucks, vans, trailers, etc.) and any supporting equipment and supplies. NPAP personnel that operate a tow trailer must review the operation/safety manuals for tow equipment, including the sway control device.

It is expected that monitoring agencies will maintain the monitoring site grounds and shelter and provide an overall safe work environment at the air monitoring stations. If a ladder is required to connect to the sample inlet, FSs should follow ladder safety guidance[2] to always maintain three points of contact. The FS must report to the Regional NPAP Lead any conditions at the site that pose a potential or imminent safety hazard or health threat to the FS, e.g., the site or sample inlet cannot be reached safely. The FS shall not proceed with an NPAP audit in this circumstance. Note that back-of-analyzer (BOA) audits are still considered valid NPAP audits when sample inlets cannot be reached safely. Conducting BOA audits require EPA Regional NPAP Lead approval.

5. Cautions/Interferences

In addition to following all safety precautions when working with compressed gas cylinders, regulator installation should be performed carefully to prevent ambient air in detached regulators from backflowing into gas cylinders, contaminating the cylinder. Entrainment of ambient air into a standard cylinder will change the certified concentrations of the standard gases, resulting in errors in conducting audits. If it is suspected that a cylinder has become contaminated, the FS should procure a replacement cylinder as soon as possible and have the suspect cylinder recertified. Details on attaching and purging a regulator are provided in Section 11.1.2.

Excessive backpressure in the NPAP plumbing will damage the gas calibrator and the analyzers. Before supplying power to the NPAP equipment, ensure that all valves used to control venting are open and ensure the sample delivery line cap has been removed.

The NPAP sample delivery line should be capped when not in use to prevent entry of debris and water. Always uncap the sample delivery line before powering on the NPAP system and do not install the cap until the audit is completed and the gas generation system is powered off. If the sample delivery line is capped when the gas calibrator begins to produce flow, the backpressure will damage the gas calibrator and O_3 analyzer (if installed).

To perform FBAs, the gas calibrator requires a customized plumbing design to fit the flow rate transfer standards in-line (see Section 7.3 for details). Be cautious and consult with vendors to determine if performing such customization yourself might void any active instrument warranties.

Audit vehicles and electrical generator exhaust contains CO and other pollutants that can interfere with conducting the audit and should be located such that the exhaust is sufficiently far from and downwind from the monitoring station inlet probe.

[2] Ladder safety information is available from the American Ladder Institute: https://www.americanladderinstitute.org/page/BasicLadderSafety

6. Personnel Qualifications/Responsibilities

Training requirements for NPAP FSs and EPA Regional Leads are detailed in the NPAP Quality Assurance Project Plan (QAPP)[3] Section A7.

Prior to conducting FBAs, FSs should be familiar with the documents listed in Table 6-1 and have documented the date reading of these documents was completed. The documents are listed in order of decreasing detail for conducting the NPAP, where 1 indicates the most detailed and 4 indicates the least detailed.

Table 6-1. Training Documents

Document[1]	Detail Level
Standard Operating Procedure for Performing Flow-Based Audits in the National Performance Audit Program (this document): https://www.epa.gov/system/files/documents/2025-09/npap_fba_sop_final_v1_508.pdf	1
NPAP QAPP: https://www.epa.gov/system/files/documents/2021-09/npap-qapp_revision-6_epa-454_b-19-012_september-14-final_0.pdf	1
Instrument Manuals for NPAP equipment (gas calibrator, ZAG, flow standards, etc.)	1
NPAP MVA SOP: https://www.epa.gov/system/files/documents/2023-08/NPAP%20SOP%20Revision%202%20March%202023_508.pdf	2
QA Handbook Vol. II: https://www.epa.gov/sites/default/files/2020-10/documents/final_handbook_document_1_17.pdf	2
NPAP Adequacy/Independence Criteria Memo (July 2018)[2] https://www.epa.gov/sites/production/files/2020-10/documents/npapadequacy072408.pdf	2
NAAQS Criteria Pollutant Gases Data Quality Objective Process https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/vol2sec03.pdf	3
40 CFR Part 50, Appendices A, C, D, and F	4
40 CFR Part 58, Appendix A	4
Transfer Standards for Calibration of Air Monitoring Analyzers for Ozone – Technical Assistance Document 2003 version (https://nepis.epa.gov/Exe/ZyPDF.cgi/P10103FQ.PDF?Dockey=P10103FQ.PDF)[2]	4
Technical Assistance Document for Precursor Gas Measurements in the NCore Multi-pollutant Monitoring Network (version 4 - 10/25/2005 EPA-454/R-05-003 Sept 2005 https://nepis.epa.gov/Exe/ZyPDF.cgi/P100ACLX.PDF?Dockey=P100ACLX.PDF)	4

1 Links were current as of October 2025.

2 Document required only for self-implementing PQAOs.

[3] As of the publication of this SOP, the NPAP QAPP is accessible on AMTIC: https://www.epa.gov/system/files/documents/2021-09/npap-qapp_revision-6_epa-454_b-19-012_september-14-final_0.pdf.

7. Equipment and Supplies

7.1. General Equipment Needs

The equipment and supplies needed for successfully conducting NPAP FBAs typically fall into three categories: audit system, support equipment, and consumables. Tables 7-1, 7-2, and 7-3 list the minimum recommended components for each category—audit system, support equipment, and consumables, respectively. These lists are not exhaustive; the FS and Regional NPAP Lead should adjust as necessary.

Table 7-1. FBA System Components

Item Description	Typical Part Number (PN) or Model and Manufacturer
Data acquisition system (DAS) software programmed to collect flow transfer standard data	Envidas Ultimate DR DAS
Windows 10 or 11 laptop/tablet personal computer (PC) with Microsoft Excel software and a copy of the FBA Workbook (current version available on the NPAP Microsoft Teams Channel)	Numerous models available – Microsoft Surface tablets have performed well in this role
Printer compatible with the laptop or tablet computer (optional if printed reports are not to be prepared) – note that laser printers typically do not suffer from clogging of print heads as occurs with inkjet printers	Numerous models available
Zero air generator (ZAG)	Teledyne API 701H or equivalent
Gas dilution calibrator[a] capable of gas-phase titration (GPT) and equipped with an O_3 generator[b] and two (preferred) or three MFCs: • Two MFCs (preferred): 0 to 20 liters per minute (LPM), and 0 to 100 cubic centimeters per minute (CCM) • Three MFCs: 2 to 20 LPM, 10 to 100 CCM, and 1 to 10 CCM.	Environics 6100/6103, Environics 9100 (no longer manufactured; vendor support likely limited), Teledyne API T700U/T703U, or equivalent
High range (diluent) flow rate transfer standards (one working and one reference): 0 to 20 LPM[c]	Alicat MB Series or equivalent
Low range (gas) flow rate transfer standards (one working and one reference): 0 to 100 CCM[c]	Alicat MWB Whisper™ Series or equivalent
Reel for polytetrafluoroethylene (PTFE) Teflon® hose with braided stainless-steel shroud	Various models available from American Reeling Devices
Delivery hose, 3/8-inch inner diameter (I.D.) polytetrafluoroethylene (PTFE) with outer braided stainless-steel shroud, ~150-ft length, 1/2-inch outer diameter (O.D.), 3/8-inch compression fitting connections	Swagelok SS-XT6TA6TA6-1800
316 Stainless Steel Nut and Ferrule Set (1 nut/1 front ferrule/1 back ferrule) for 3/8-inch tube fitting	Swagelok SS-600-NFSET
316 Stainless Steel Nut and Ferrule Set (1 nut/1 front ferrule/1 back ferrule) for 1/4-inch tube fitting[c]	Swagelok SS-400-NFSET
316 Stainless Steel Nut and Ferrule Set (1 nut/1 front ferrule/1 back ferrule) for 1/8-inch tube fitting[c]	Swagelok SS-200-NFSET

Item Description	Typical Part Number (PN) or Model and Manufacturer
Stainless Steel Swagelok Tube Fitting, Male Connector, 1/2-inch Tube O.D. x 1/2-inch Male National Pipe Thread (NPT)	Swagelok SS-810-1-8
Stainless Steel Swagelok Tube Fitting, Male Tube Adapter, 1/2-in. Tube O.D. x 1/2-in. Male NPT	Swagelok SS-8-TA-1-8
Stainless Steel Swagelok Tube Fitting, Union Elbow, 1/2-in. Tube O.D.	Swagelok SS-810-9
Manual toggle valve, 1/4-in tube fittings	Swagelok SS-1GS4
PTFE plug for 1/4-inch Swagelok tube fitting	Swagelok T-400-P
PTFE Swagelok tube fitting, union, 1/4-inch tube O.D.	Swagelok T-400-6
PTFE Swagelok tube fitting, reducing union, 3/8-inch x 1/4-inch tube O.D.	Swagelok T-600-6-4
PTFE Swagelok tube fitting, reducing union, 1/4-inch x 1/8 inch tube O.D.	Swagelok T-400-6-2
PTFE plug for 1/8-inch Swagelok tube fitting	Swagelok T-200-P
FEP Teflon® tubing: 1/8-inch O.D., 1/16-inch I.D., 1/32-inch wall thickness[c]	Cole Parmer EW-50119-15
FEP Teflon® tubing: 1/4-inch O.D., 1/8-inch I.D., 1/16-inch wall thickness[c]	Cole Parmer EW-06450-05
FEP Teflon® tubing: 1/2-inch O.D., 3/8-inch I.D., 1/16-inch wall thickness	Cole Parmer EW-06450-09
PTFE Swagelok tube fitting, union tee, 1/4-inch tube O.D.	Swagelok T-400-3
FEP Teflon® bag, approximately 12” x 12”	American Durafilm Duralok 3 mil, or equivalent
316/316L stainless steel seamless tubing, 1/4-inch O.D. x 0.035-inch wall thickness x 20 ft	Swagelok SS-T4-S-035-20
316 stainless steel Swagelok tube fitting, male elbow, 1/8-inch tube O.D. x 1/4-inch male NPT	Swagelok SS-200-2-4
316 stainless steel plug for 1/4-inch Swagelok tube fitting	Swagelok SS-400-P
Multiblend gas cylinder with concentrations of National Institute of Standards and Technology (NIST)-traceable EPA protocol gases in the following ranges: CO: 425 to 575 ppm SO_2: 13 to 20 ppm NO: 25 to 35 ppm	Appropriate Ambient Air Protocol Gas Verification Program (AA-PGVP) compliant gas vendor
NO scrubber[d]: refillable scrubber assembly Purafil® (or equivalent) 1/8-inch pellets fiberglass wool	 Thermo PN 6996 Thermo PN 7075 Corning PN 3950

Item Description	Typical Part Number (PN) or Model and Manufacturer
Charcoal scrubber[d]: refillable scrubber assembly activated charcoal fiberglass wool	 Thermo PN 4291 Thermo PN 4157 Corning PN 3950
Palladium (Pd) scrubber[d]: refillable hydrocarbon trap palladium on 1/8-inch alumina pellets, 0.5% Pd fiberglass wool	 Restek PN 22013 Acros Organics PN 195082500 Corning PN 3950
Multiblend gas cylinder regulator Outlet pressure: 0 to 50 pounds per square inch (psig) Inlet gauge: 0 to 4000 psig 316L Stainless Steel CGA 660	CONCOA 408-1031-660 or equivalent
Clam shell regulator cover - 7 threads per inch	Griftan Inc. GT-7
Delivery manifold borosilicate glass or PTFE Teflon® 3 ports minimum	Custom manufactured
Verification manifold borosilicate glass or PTFE 3 ports minimum	Custom manufactured
Needle valves for NPAP system vents	Parker 4Z-VLK-SS (preferred) or 4Z-V4LN-SS
316L stainless steel Swagelok tube fitting, union tee, 1/4-inch tube OD	Swagelok 316L-400-3
Two rotameters to measure NPAP system vent flow, measurement range 0 to 1.0 LPM	Dwyer VFA-21
manual solenoid valves, 2-way, normally closed, PTFE seal material, 1/4-inch pipe size	Swagelok SS-DLS4
3-way manual valves	Swagelok SS-43GXS4

[a] Custom adjustment to the flow path configuration of the gas dilution calibrator is required to incorporate the flow rate transfer standard measurement. See Section 7.3 for details on the configuration modification.

[b] O_3 generator must be capable of generating 5 to 400 parts per billion (ppb) ozone at 16 LPM with concentration accuracy ±2%.

[c] Tubing and fittings needed for the gas calibrator custom flow path configuration. See Section 7.3 for details on the configuration modification.

[d] Details on the external NO, Charcoal, and Palladium scrubbers can be found in Appendix A.

Table 7-2. Support Equipment

Item Description
Generator or battery power supply with sufficient wattage capacity to power the necessary support equipment [a]
Uninterruptible power supply with alternating current (AC) power conditioner capable of powering a gas calibrator, O_3 analyzer, and PC [a]
Air conditioner capable of maintaining required temperature range and minimizing temperature fluctuation within the FS mobile laboratory [a]
Thermometer to monitor FS mobile laboratory temperature [a]
Toolbox with a variety of standard hand tools: e.g., screwdrivers, adjustable wrenches, pliers
ladder, aluminum construction recommended, minimum 20-ft, A-frame/extension combination
rope, 300 lb. weight capacity, ≥ 75-ft
heavy-duty, grounded, weatherproof electrical extension cords with multiple outlets, ≥ 25-ft, 10A, quantity 2

[a] Items applicable to vehicle-based audit systems.

Table 7-3. Consumables

Item Description
zero air generator maintenance supplies: - Purafil® - activated carbon - particulate filter - molecular sieve - CO scrubber - dryer
External scrubber system maintenance supplies: - Purafil® - activated carbon
engine oil [a]
generator engine oil [a]
engine coolant [a]
generator coolant [a]
lint-free laboratory wipes
first-aid kit
fire extinguisher
insect repellant

[a] Items applicable only to vehicle-based audit systems.

7.2. Equipment Configuration and Construction

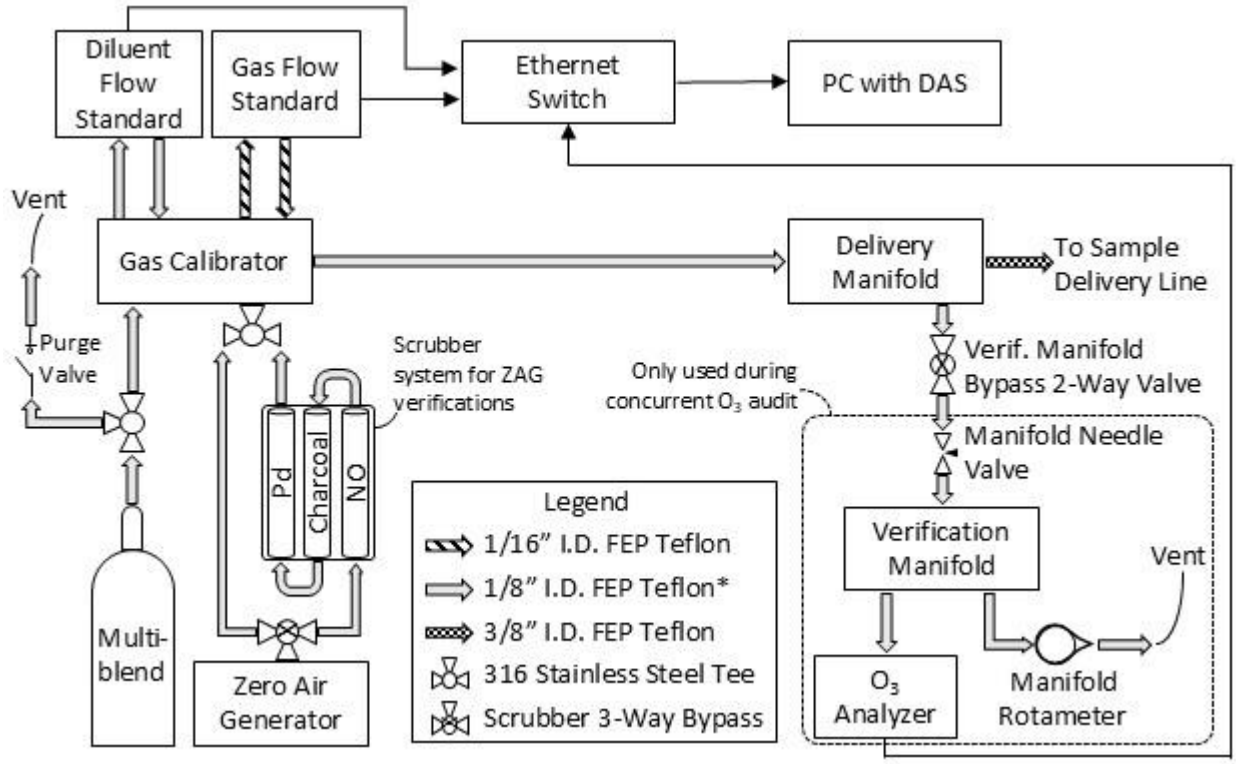
Figure 7-1 presents a simplified plumbing schematic of the FBA system. This design is applicable to both vehicle-based and/or case-based configurations. For simplification, analyzer exhausts are not depicted.

The sensitivity of the employed ambient air monitoring instruments to excess pressure requires adequate venting to ensure the instruments do not experience overpressure conditions. Vents are included off the multiblend tank, the verification manifold (used only during O_3 audits), and the station's inlet connection (not pictured; more details in Section 9.5.4). It is critical that appropriate venting occurs to prevent potential instrument damage.

The order in which the scrubber system is assembled relative to the direction of air flow is important. The ZAG generated zero air should first pass through the NO scrubber, then the Charcoal scrubber, and lastly the Pd scrubber. The NO scrubber oxidizes NO to NO_2. It is important that the NO scrubber is upstream of the Charcoal scrubber to ensure all NO is converted prior to the charcoal scrubber removing NO_2. The Charcoal scrubber also removes SO_2. It is important that the Charcoal scrubber is upstream of the Pd scrubber to ensure all SO_2 is scrubbed prior to entry into the Pd scrubber as SO_2 can damage the latter.

Per Section 2.6(a) of 40 CFR Part 58 Appendix E, materials in the sampling train (from probe inlet to the back of the monitor) for SO_2, NO_2, and O_3 may consist of only FEP Teflon®, borosilicate glass, or their equivalent. In practice, the composition of materials contacting gases delivered to the station inlet should consist only of FEP Teflon® or borosilicate glass. One exception to this rule is for the NPAP sampling train between the multiblend tank and the gas calibrator. Per *EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards* (EPA 600/R-12/531), stainless steel is recognized as an acceptable material for gas handling. Therefore, either FEP Teflon® or silco-coated stainless steel tubing is acceptable for this portion of the NPAP sampling train.

As much as possible, connections and lines for delivering gases containing O_3, $NO/NO_2/NOx$, and/or SO_2 should avoid the use of incompatible materials and consist of only FEP Teflon® or borosilicate glass. As noted above, stainless steel is also acceptable between the multiblend tank and gas calibrator. Special consideration must be given for materials other than these if installed in the audit system to ensure they do not come in contact with generated test gases. This is difficult to achieve in practice as wetted surfaces of interior flow paths of gas calibrators and MFCs typically include some stainless steel. Wetted surfaces contacting only CO or zero air (nominally nonreactive gases) may be constructed of stainless steel.



* *The 1/8" I.D. tubing in the sampling train between the multiblend tank and the gas calibrator may be either FEP Teflon or silco-coated stainless steel.*

Figure 7-1. NPAP FBA Plumbing Schematic

7.3. Gas Calibrator Custom Configuration

The gas dilution calibrator's flow path configuration must be modified to incorporate the flow rate transfer standards in-line with the measurement system. In general, the FBA requires installation of associated fittings and tubing to add an in-line route for output flow from the gas calibrator to the flow rate transfer standards. The transfer standards must be routed immediately downstream of the MFCs and upstream of the O_3 generator and mixing/reaction chamber. Vendors may offer to provide this customization for a fee. For example, Environics® has previously quoted (on 2024-01-01) $300 to add a 'loop-back plumbing for flow checks' per MFC for the 6100 series calibrator. The custom plumbing is simple enough that it can easily be done in-house. However, be cautious and consult with vendors to determine if performing the customization yourself will void any active instrument warranties.

Depending on the make/model of gas calibrator, two (2) or three (3) internal MFCs may be used to perform the dynamic dilution. Customizing to perform FBAs is possible for either setup, with only one notable difference in the plumbing design. Regardless of the number of internal MFCs used, they can be grouped into two sets:

- **Set 1**: A single MFC is used to control the dilution flow, i.e., zero-air. This MFC controls a relatively higher flow rate generally between 0 – 20 LPM.
- **Set 2**: One to two MFCs are used to control the gas flow, i.e., that from the multiblend tank. These MFCs control a relatively lower flow rate.
    - For gas calibrators with one gas flow control MFC, the flow is generally between 0 – 100 CCM.

- For gas calibrators with two gas flow control MFCs, the flows are generally between 1 – 10 CCM and 10 – 100 CCM.

Regardless of whether the gas calibrator uses two or three total MFCs, only two flow rate transfer standards are required—one for each of the 'Sets' described above. Namely, whether Set 2 includes one or two MFCs, only one downstream transfer standard is required. However, Regions may still optionally choose to use an individual standard for each of the MFCs in Set 2. For gas calibrators in which Set 2 includes two MFCs, either:

- An external tee can be used to join the two MFC flows prior to passage through a single transfer standard (preferred), or
- The two MFCs can each be connected to their own downstream transfer standard (optional).

Figure 7-2 and Figure 7-3 illustrate the plumbing schematic for gas calibrators operating two and three total MFCs, respectively. Note, Figure 7-3 depicts the setup with two total transfer standards (utilizing the external Tee noted above) and does not show the optional setup in which three total transfer standards are plumbed. Figure 7-4 shows the final product of a customized setup, in which two Alicat flow rate transfer standards are plumbed in-line and after the MFCs on an Environics® 6100 series gas calibrator.

The flow rate transfer standards should be plumbed immediately downstream of the MFCs. Tubing to connect the transfer standards should be FEP Teflon® and the length of tubing should be minimized to prevent a potential pressure drop in the system. Testing has shown that 3 ft long tubing is sufficiently long enough to complete the setup and not too long to impact pressure and subsequent measurements. The tubing diameters should match the calibrator's tubing diameter from the given MFC. Generally, the diluent flow MFC tubing is 1/4-inch O.D. and 1/8-inch I.D., whereas the gas flow MFC tubing is 1/8-inch O.D. and 1/16-inch I.D. Table 7-1 lists the fitting and tubing item descriptions and typical part numbers necessary for this customization and includes:

- Diluent line connection:
  - FEP Teflon® tubing: ≤ 3 ft length, 1/4-inch O.D., 1/8-inch I.D., 1/16-inch wall thickness (Cole Parmer EW-06450-05)
  - 316 Stainless Steel Nut and Ferrule Set (1 nut/1 front ferrule/1 back ferrule) for 1/4-inch tube fitting (Swagelok SS-400-NFSET)
- Gas line connection:
  - FEP Teflon® tubing: ≤ 3 ft length, 1/8-inch O.D., 1/16-inch I.D., 1/32-inch wall thickness (Cole Parmer EW-50119-15)
  - 316 Stainless Steel Nut and Ferrule Set (1 nut/1 front ferrule/1 back ferrule) for 1/8-inch tube fitting (Swagelok SS-200-NFSET)
  - 316L stainless steel Swagelok tube fitting, union tee, 1/8-inch tube O.D. (Swagelok SS-200-3JA). Note, this tee is only required for gas calibrators that utilize two (2) MFCs to control the gas flow and setups with a single gas flow standard.

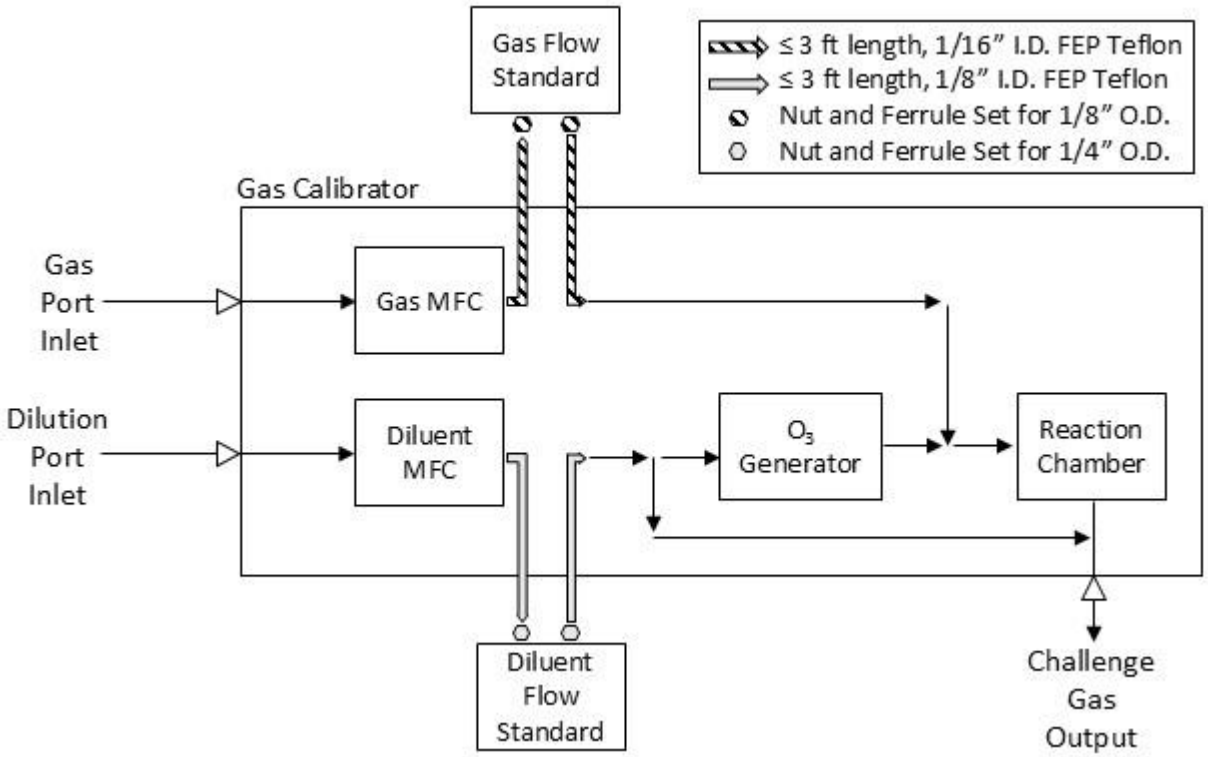


Figure 7-2. Simplified Custom Plumbing Schematic for Gas Calibrator with Two MFCs

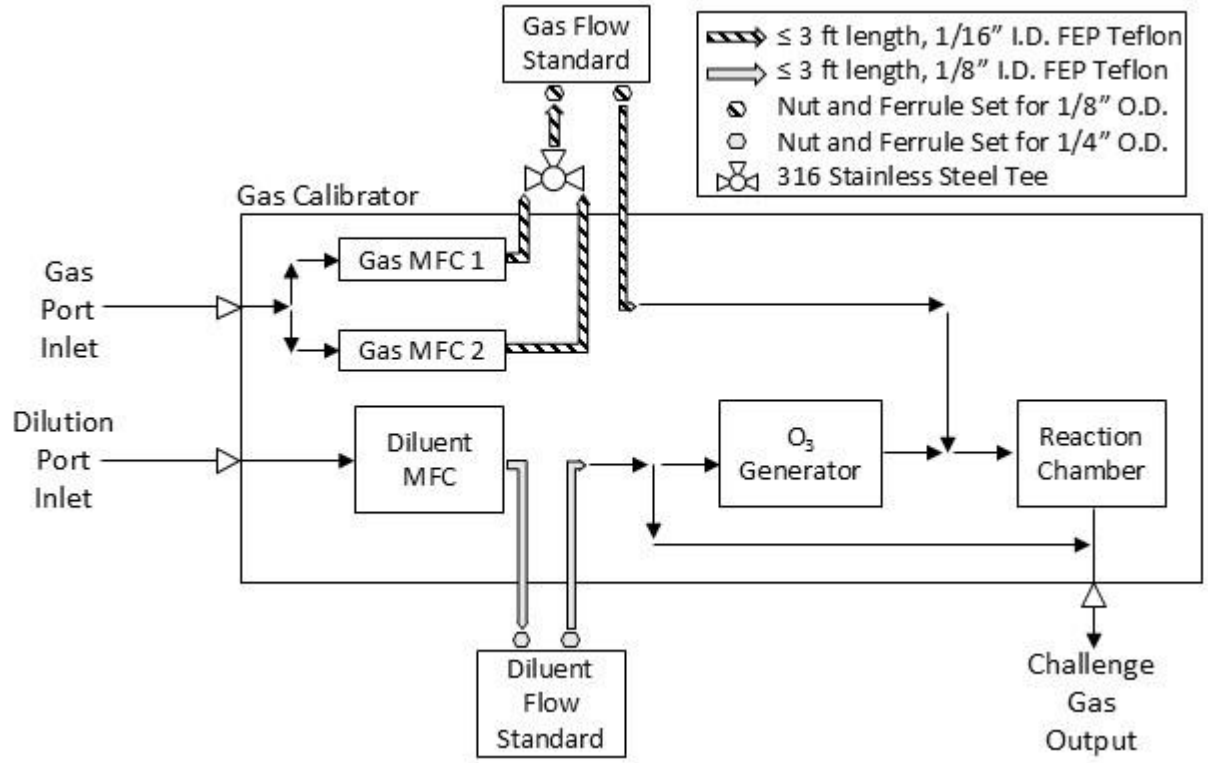


Figure 7-3. Simplified Custom Plumbing Schematic for Gas Calibrator with Three MFCs

Figure 7-4. Alicat Flow Rate Transfer Standards Plumbed in-line with an Environics® 6100 Gas Calibrator

8. Reagents and Standards

CO, SO_2, and NO are sourced from a NIST-traceable certified multi-component gas cylinder. The multiblend cylinder must be purchased and subsequently reverified minimally annually by either of the verification labs in Regions 4 or 7, or by an appropriate AA-PGVP compliant gas vendor.

9. Procedures

9.1. General Audit Considerations

The goal of the NPAP is to objectively assess the performance of the ambient air monitoring equipment at the site in its current condition, rather than to facilitate or encourage a passing audit. Audit outcomes reflect on the quality of the concentration data reported by the site, thus data reported recently by the site before a failing audit will be reviewed to evaluate the impact of the measurement excursion from the certified test gas concentrations. FSs perform audits on ambient air monitoring stations as-is and may not permit the monitoring site operator or others to adjust the station analyzer calibration or measurement equipment (e.g., fix loose intake connections). While problems with the site operation or configuration may be obvious prior to or during the audit, FSs may not suggest corrective action (such as cleaning dirty inlets) before the audit has been completed, as this compromises the primary goal of the NPAP. FSs are responsible for making an unbiased assessment of an air monitoring station's ability to measure criteria pollutant concentrations.

The Regional NPAP Lead has sole discretion as to whether the FS can offer suggestions on corrective actions to the site operator to improve performance once the audit is complete; however, such suggestions cannot be made until the audit is concluded. Such suggestions are not required, and in fact, may not be permitted by the Regional NPAP Lead. Further, FSs do not have the responsibility or authority to prescribe official corrective actions. Due to potential liability and the impact it may have on the monitoring agency's ability to measure and report criteria pollutant measurements, FSs are not permitted to assist in the implementation of corrective actions or any other structural changes to ambient air monitoring stations.

Audit results are considered preliminary and unofficial until reviewed, approved, and uploaded to the Air Quality System (AQS) by the respective EPA Regional NPAP Lead.

Audit vehicles and electrical generator exhaust contains CO and other pollutants that can interfere with conducting the audit and should be located such that the exhaust is sufficiently far from and downwind from the monitoring station inlet probe.

The FS should communicate the expectation that the site operator should report their measurements to the FS in the same manner that measurements are reported to AQS for ambient air measurements. Practically, this means that sampling frequencies and measurement data handling characteristics such as truncation, averaging, rounding, and significant digits should be consistent with those employed for the routine measurement and reporting of ambient air concentrations.

The nominal challenge concentrations for CO, SO_2, and NO are calculated based on the certified concentrations in the multiblend cylinder and standardized (via two flow rate transfer standards) gas calibrator standard and diluent gas flow rates.

NO_2 audit results rely on the NPAP NO calculated concentrations and reference the site-measured NO concentrations to construct a linear regression of the site NO monitor. The NO concentrations measured by the site corrected for the linear regression are input into a calculation to determine the NO before and after generating NO_2 by GPT to determine the challenge NO_2 concentrations.

Note that the current NPAP FBA procedure does not allow for auditing of direct-read NO_2 analyzers in air monitoring networks. At the time of this SOPs release, EPA is developing a new procedure to audit direct-read NO_2 instruments.

9.2. Audit Test Gas Flow Rate

The gas analyzers employed in ambient air monitoring are equipped with air sampling pumps and are engineered to sample ambient air at a nominal flow rate and at normal atmospheric pressures. Therefore, over pressurizing the sample inlet of these analyzers during auditing will likely result in erroneous measurements and possibly damage the equipment. To avoid over-pressurization, the total audit flow rate is recommended to be 16 LPM and maintained within ± 1 LPM with a bypass vent installed in the delivery line at the station inlet probe as described in Section 9.5.4. Much of the generated test gas is exhausted out of this bypass vent when conducting TTP audits to ensure that station analyzers are not over-pressurized and that ambient air does not become entrained in the test gas, diluting or contaminating the test gas. The recommended flow rate of 16 LPM has been demonstrated in most cases to provide sufficient flow to provide sufficient test gas to the onboard NPAP analyzer (only applicable when concurrently conducting an

O_3 audit) and the station analyzers without over-pressurization while ensuring ambient air is not entrained in the test gas.

Although 16 LPM is typically a proper flow rate, FSs should verify the required flow rate. To estimate the audit gas flow rate provided to air monitoring stations, sum the total demand of operating station analyzers, the NPAP O_3 audit analyzer (if concurrently conducting an O_3 audit), and of manifold vents (the verification manifold vent, used during O_3 audits, should vent approximately 0.4 LPM) to ensure excess audit gas is provided. The excess audit gas flow should be no less than 1-2 LPM, though will typically be higher (e.g., approximately 5 LPM).

The following is an example calculation of the audit gas flow demand to ensure excess flow is vented:

> Most ambient air analyzers sample at a flow rate of approximately 1.1 LPM. If the NPAP O_3 analyzer is operating, its gas demand is 1.1 LPM and the verification manifold should vent approximately 0.4 LPM to ensure the analyzer is not over pressurized. If the air monitoring station is operating O_3, CO, SO_2, and NO_2 monitors (each at 1.1 LPM), their total demand is 4.4 LPM. If the FS is supplying 16 LPM of test gas, the gas vented at the station inlet is determined by subtracting the total known vent and demand from the total supplied.
>
> In this case 1.1 LPM (NPAP O_3 analyzer), 0.4 LPM (manifold vent), and 4.4 LPM (station instruments) are subtracted from 16 LPM for an excess flow of 10.1 LPM.

If the air monitoring site utilizes a blower to pull air through the sampling manifold supplying ambient air to multiple analyzers, the blower must be turned off during the audit. In such configurations, the manifold blower pulls a high flow rate (typically much more than 16 LPM) and will consume the audit gas flow and make up the remaining flow with ambient air, failing to flood the manifold with test gas and diluting or contaminating the test gas. For manifolds with blower configurations, the blower will serve as a vent, therefore an additional vent should not be installed on the delivery line connection at the sampling inlet.

9.3. Audit Concentrations Selection

The NPAP audit concentration level ranges are shown in Table 9-1. Per Section B1.1 of the NPAP QAPP, every NPAP audit must include audit points in Levels 2, 3, 4, and 5 (rows in yellow). Further, if time and monitoring site instrument sensitivity allows, the FS should also audit at a concentration in Level 1 (row in pink). No audit points should be conducted in Levels 6-10 without the approval of the Regional NPAP Lead. However, if the monitoring station routinely measures criteria pollutant gases at concentrations above Level 5, the Regional NPAP Lead may approve adding additional audit concentration points in Levels 6-10.

Table 9-1. NPAP Audit Concentration Levels

Audit Level	Challenge Concentration Ranges (ppm)			
	CO	SO_2	NO_2	O_3[a]
1	0.020 - 0.059	0.0003 - 0.0029	0.0003 - 0.0029	0.0040 - 0.0059
2	0.060 - 0.199	0.0030 - 0.0049	0.0030 - 0.0049	0.0060 - 0.019
3	0.200 - 0.899	0.0050 - 0.0079	0.0050 - 0.0079	0.020 - 0.039
4	0.900 - 2.999	0.0080 - 0.0199	0.0080 - 0.0199	0.040 - 0.069
5	3.000 - 7.999	0.0200 - 0.0499	0.0200 - 0.0499	0.070 - 0.089
6	8.000 - 15.999	0.0500 - 0.0999	0.0500 - 0.0999	0.090 - 0.119
7	16.000 - 30.999	0.1000 - 0.1499	0.1000 - 0.2999	0.120 - 0.139
8	31.000 - 39.999	0.1500 - 0.2599	0.3000 - 0.4999	0.140 - 0.169
9	40.000 - 49.999	0.2600 - 0.7999	0.5000 - 0.7999	0.170 - 0.189
10	50.000 - 60.000	0.8000 - 1.000	0.8000 - 1.000	0.190 - 0.259

[a] Ozone cannot be audited via the FBA method. Included here for completeness.

Formal audit evaluation (e.g., pass/fail) is based on monitoring station performance in Levels 3-10. Levels 1 and 2 are generally not considered in the audit evaluation and intended only for EPA to collect data on monitoring network performance at these lower concentration levels. Note, however, Regions can additionally require pass/fail be evaluated for Levels 1 and 2. Acceptance criteria for NPAP audits are defined in Table 9-2.

Table 9-2. NPAP Audit Acceptance Criteria

Criteria Gas	Audit Levels	Acceptance Criteria (absolute or percent difference)
CO	1 – 2	Either ≤ ± 0.030 ppb or ≤ ± 15.0%
	3 – 10	≤ ± 15.0%
SO_2	1 – 2	Either ≤ ± 1.50 ppb or ≤ ± 15.0%
	3 – 10	≤ ± 15.0%
NO_2	1 – 2	Either ≤ ± 1.50 ppb or ≤ ± 15.0%
	3 – 10	≤ ± 15.0%
O_3[a]	1 – 2	Either ≤ ± 1.50 ppb or ≤ ± 10.0%
	3 – 10	≤ ± 10.0%

[a] Ozone cannot be audited via the FBA method. Included here for completeness.

9.4. Concentration Stability

Concentrations of audit test gases provided to the monitoring station must be stable before the site operator can provide a measurement. For FBAs, test gas stability occurs once (1) the flow rates from the gas calibrator MFCs are stable and (2) the sampling line is fully and uniformly flooded with the selected concentration output from the gas calibrator. Generally, MFC stability (can be confirmed via the flow rate transfer standard readings) and sampling line concentration uniformity should not take more than a minute assuming the sampling line is fully conditioned.

For the first audit concentration point (typically Level 5; not the pre-zero audit point), the FS will generate the test gas for minimally 10 minutes prior to informing the station operator that a measurement can be made when their measurement is stable. For all other audit points, the FS will generate the test gas at a respective concentration for minimally 1 minutes prior to notifying the station operator. Note, the additional time for the first concentration point is to allow for sufficient sampling line conditioning. Also note, these are only the minimum required wait times. FSs must be cognizant of when their NPAP system is sufficiently stable and may choose to wait longer to ensure stability.

Following the timeframes described above, the FS will notify the station operator when the audit test gas concentration is acceptably stable, at which point the station operator should use their own judgement when the station's concentration is stable for reporting a concentration measurement. **FSs may decide, but are not obligated, to wait more than 60 minutes for the station analyzer to stabilize and the site operator to provide a measurement for the first audit concentration point (typically Level 5; not the pre-zero audit point). For all other audit points, FSs are not obligated to wait more than 30 minutes.** If operating properly, the station analyzer should reach stability well within these times. The Quality Assurance Handbook for Air Pollution Measurement Systems Volume II notes the following regarding stability wait time when challenging an analyzer with a test gas:

> *At a minimum, the operator should allow the challenge gas to saturate the delivery system, then wait at least the analyzer's lag[4] and rise[5] time (see 40 CFR §53.23) for each targeted concentration level. These two parameters, however, are not meant as a measure of when an instrument is stable enough to take a reading, but rather serve as a mark of the time the instrument takes to respond to a change in the test concentration. The longer the operator waits to take a reading, the better the results. At a minimum, EPA recommends that an operator wait 5 additional minutes after the analyzer has begun to measure consistent, instantaneous concentrations that show minimal variability and no discernible slope.*

Table B-1 to Subpart B of 40 CFR Part 53 defines the following performance limit specifications for SO_2, O_3, CO, and NO_2 instruments:

- For SO_2, O_3, and CO analyzers, the lag, rise, and fall time must be within 2 minutes.
- For NO_2 analyzers, the lag time must be within 20 minutes and rise/fall time within 15 minutes.

Therefore, 60 minutes (first audit concentration point) and 30 minutes (all other audit points) should provide substantial time for station analyzer stability to occur after challenging with a test gas. **If the site operator refuses to provide a concentration value after the 60 or 30 minutes and when requested by the FS, the audit point can be failed. In this scenario, the FS should inform the Regional NPAP Lead of the situation and request further guidance.**

[4] Lag time: The time interval between a step change in input concentration and the first observable corresponding change in measurement response. 40 CFR §53.23(e)(iii)
[5] Rise time: The time interval between initial measurement response and 95 percent of final response after a step increase in input concentration. 40 CFR §53.23(e)(iv)

9.5. Conducting the FBA

Audit procedures presented in this section refer to the equipment and plumbing schematic in Figure 7-1.

Warning: Excessive backpressure in the NPAP plumbing will damage the gas calibrator. Before supplying power to the NPAP equipment, ensure that all valves used to control venting are open and ensure the sample delivery line cap has been removed.

The NPAP sample delivery line should be capped when not in use to prevent entry of debris and water. Always uncap the sample delivery line before powering on the NPAP system and do not install the cap until the audit is completed and the gas generation system is powered off. If the sample delivery line is capped when the gas calibrator begins to produce flow, the backpressure will damage the gas calibrator.

9.5.1. Delivery Line Conditioning

The delivery hose must be conditioned with ozone prior to every FBA. To ensure audits are conducted efficiently and are considerate of station operator time, auditors should condition the line sufficiently in advance where possible. The conditioning requirements is dependent on how long the system has been idle:

1. **If the system has been idle for over a week**: Condition the delivery line with ~150 ppb ozone for several days at ~16 LPM.
2. **If the system has been idle up to a week**: Condition the delivery line with ~15 ppb ozone for several days at ~16 LPM.
3. **Regardless of idle time and prior to every FBA**:
    a. Position the outlet of the delivery hose such that its exhaust will not interfere with ambient air measurements at the monitoring site.
    b. Condition the delivery line with ~500 ppb ozone for minimally one hour at ~16 LPM.

9.5.2. Site Information Confirmation

Approximately one week (or more) before the audit, the FS should complete the **Monitor Information** tab of the FBA Workbook. The FS must ensure they are using the most up-to-date version of the FBA Workbook prior to every audit. The current version of the FBA Workbook is maintained on the NPAP Teams Channel and is routinely updated with the latest AQS data. The naming convention of the FBA Workbook includes the date it was most recently updated (e.g., *FBA_Workbook_v**2025-06-17**.xlsx*). The following steps detail how to complete these entries in the FBA Workbook.

1. Open the current version of the FBA Workbook and select the **Monitor Information** tab.
2. Complete all relevant fields under the *General Audit Information* (Figure 9-1), *Site Information* (Figure 9-2), *Station Monitor Information* (Figure 9-3), *NPAP Instruments Information* (Figure 9-4), and *NPAP Multiblend Gas Cylinder Information* (Figure 9-5) tables.
3. All relevant fields should be entered in these tables, but **the parameters in red font color include information that is required for audit data to upload to AQS**. These fields must be properly filled, or the auto-completed AQS transaction strings generated on another tab of the FBA Workbook

(detailed in Section 9.6) will be incomplete and the audit data will not successfully upload to AQS. The required entries include:

a. **Auditing Entity (Region/State/Other)**: The organization (EPA Region, Self-Implementor, or Contractor) performing the NPAP audit. This field itself is not included in the AQS upload; however, the entry here auto-completes the 'Audit Agency' field, which is included in the AQS transaction.
b. **Audit Date**: The date the NPAP audit is conducted.
c. **Audit Type**: Either TTP or BOA. The majority, if not all, NPAP audits conducted should be TTP.
d. **State Code**: Two-digit state code associated with the monitoring site being audited.
e. **County Code**: Three-digit county code associated with the monitoring site being audited.
f. **Site ID**: Four-digit site ID associated with the monitoring site being audited.
g. **POC**: The primary occurrence code (one to two-digit), which is a unique monitor identifier for each parameter, of the monitor being audited. Note, this field is auto populated based on other user entries (i.e., state code, county code, site ID). The FS should ensure the accuracy of this field and manually override (in *Manual Override (if AQS-derived inaccurate)* column) if the auto-filled cell is determined to be inaccurate.
h. **AQS Method Code**: The three-digit method code associated with the site monitor being audited. Note, this field is auto populated based on other user entries (i.e., state code, county code, site ID, and POC). The FS should ensure the accuracy of this field and manually override (in *Manual Override (if AQS-derived inaccurate)* column) if the auto-filled cell is determined to be inaccurate.

General Audit Information	
Auditing Entity (Region/State/Other)	Region 4
Audit Agency	1099
NPAP Auditor:	Cooper Flagg
Station Manager:	Mike Krzyzewski
Audit Date:	2025-07-09
Audit Type:	TTP

Figure 9-1. The *General Audit Information* Table in the Monitor Information Tab

Site Information		
Parameter	AQS Derived/Filtered Info.	Manual Override (if AQS-derived inaccurate)
State Code	37	
County Code	183	
Site ID	0014	
AQS ID	37-183-0014	
Site Name:	Millbrook School	
Site Address:	3801 SPRING FOREST RD.	
Site Latitude (decimal degrees):	35.856111	
Site Longitude (decimal degrees):	-78.574167	

Figure 9-2. The *Site Information* Table in the Monitor Information Tab

Station Monitor Information						
Pollutant/Parameter	AQS Derived/Filtered Info.			Manual Override (if AQS-derived inaccurate)		
	CO	SO_2	NO_2	CO	SO_2	NO_2
POC	2	2	3			
Monitor	37-183-0014-42101-2	37-183-0014-42401-2	37-183-0014-42602-3			
AQS Method Code	554	560	212			
Manufacturer	THERMO	THERMO	TELEDYNE API			
Model Number	48i-TLE	43c-TLE	T500U			
Serial Number	abc-123	def-456	ghi-789			
Calibration Date	2025-06-04	2025-02-12	2025-05-08			
PQAO:	0776	0776	0776			

Figure 9-3. The *Station Monitor Information* Table in the Monitor Information Tab

NPAP Instruments Information						
Instrument	Flow Transfer Standard: High Range (Diluent)	Flow Transfer Standard: Low Range 1 (Gas)	Flow Transfer Standard: Low Range 2 (Gas; if applic.)	Gas Calibrator: Ozone Generator	Gas Calibrator: MFCs	Zero Air Generator
Manufacturer	Alicat	Alicat		TELEDYNE API	TELEDYNE API	TELEDYNE API
Model	MB20SLPM	MB100SCCM		T700U	T700U	701H
Serial Number	382126	382125		efg5678	efg5678	hij91011
Last Verification/Certification	2024-06-25	2025-06-29		2025-07-03	2025-07-09	2025-07-02

Figure 9-4. The *NPAP Instruments Information* Table in the Monitor Information Tab

NPAP Multiblend Gas Cylinder Information		
Vendor		Airgas
Cylinder Serial #		3AA2400
Size (ft^3)		300
CGA Valve		660
Cylinder Expiration Date		2030-01-01
Pollutant Verification Date	CO	2025-05-13
	SO_2	2025-05-12
	NO	2025-05-14
	NOx	2025-05-14

Figure 9-5. The *NPAP Multiblend Gas Cylinder Information* Table in the Monitor Information Tab

After completing the **Monitor Information** tab, the FS must distribute the site and station monitor information to the site operator to confirm the data are accurate. If inaccuracies are noted, the FS must correct the data in the FBA Workbook using the "Manual Override" fields. Inaccuracies can occur from either:

1. AQS metadata not matching actual site conditions. For these cases, the FS should notify the EPA Regional NPAP Lead who should coordinate with the monitoring agency, noting the discrepancy and request that the AQS metadata are updated to accurately reflect site conditions.
2. The FBA Workbook auto-generated information (based on routinely queried AQS data) is outdated. For these cases, the FS should notify the EPA Regional NPAP Lead who can request the EPA OAQPS NPAP Lead to provide an updated version of the FBA Workbook to the NPAP Teams Channel.

Once on site, the FS will independently verify the site (e.g., latitude and longitude) and monitor (e.g., POC, method code, manufacturer and model) information are accurate on the "Site Information" and "Station Monitor Information" tables of the **Monitor Information** tab, respectively. Any discrepancies observed during this independent verification must be corrected on the FBA Workbook using the "Manual Override"

fields and the EPA Regional NPAP Lead must be notified. This can be documented in the Manual Comments table at the bottom of the tab.

9.5.3. Data Acquisition Initialization

To initialize data acquisition, turn on the NPAP laptop/tablet computer, start the DAS, and ensure that measurement data (e.g., the flow rate transfer standards' flow reading outputs) captured by the DAS are being properly recorded and displayed.

9.5.4. Connecting the Delivery Line to the Station Inlet

It is expected that monitoring agencies will maintain the monitoring site grounds and shelter and provide an overall safe work environment at the air monitoring stations. If a ladder is required to connect to the sample inlet, follow all applicable safety precautions. If the site or sample inlet cannot be reached safely then the FS should immediately contact the Regional NPAP Lead to discuss next steps. Note that BOA audits are still considered valid NPAP audits when sample inlets cannot be reached safely. Conducting BOA audits require EPA Regional NPAP Lead approval.

Prior to unreeling the sample delivery line and introducing audit gas in the vicinity of the station inlet, request that the site operator cease reporting data to AQS, i.e., down the channel. Failure to down the channel will not affect audit measurements but may result in reporting data to AQS for the provided audit gases.

There are two typical configurations for connecting the audit delivery hose to a station inlet:

1. A secure "hard" plumbing connection to the inlet probe tubing (preferred; Section 9.5.4.1), and
2. A "soft" plumbing connection employing a Teflon bag to shroud the inlet when a hard connection cannot be secured (Section 9.5.4.2).

9.5.4.1. Hard Connection to Inlet Probe Tubing

The most common inlet configuration employed at ambient air monitoring sites consists of 1/4-inch O.D. Teflon® tubing shrouded by a borosilicate glass or stainless-steel funnel as a rain shield. For such inlet configurations, connect the delivery line to the monitoring station inlet tubing with Teflon® connection fittings as shown in Figure 9-6 and Figure 9-7. The FS should bring extra Teflon® connection fittings in case they are needed to complete the connection of the NPAP sample delivery line.

To ensure the excess audit gas pressure is vented, construct a vent using a tee and an additional length of Teflon tubing (as shown in Figure 9-6). The vent tubing should be minimally 10 inches in length to prevent ambient air entrainment. If conditions are windy, a longer vent tube may be needed to reduce the influence wind has on the flow provided to the station inlet. For manifolds with blower configurations, the blower (turned off for the audit) will serve as a vent, therefore an additional vent should not be installed on the delivery line connection at the sampling inlet (see Section 9.2 for more details on stations utilizing blowers). FSs should be careful not to inadvertently cap the delivery line (as when adding tees and vents) as this will result in backpressure that will damage the gas dilution calibrator.

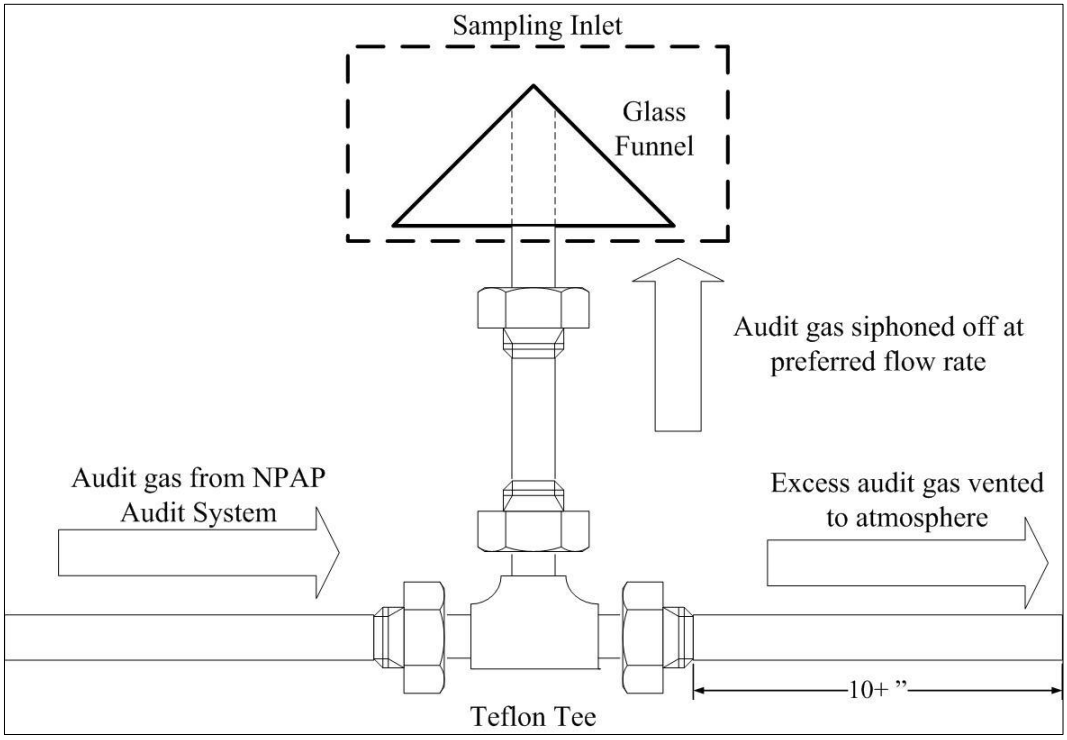


Figure 9-6. Hard Connection to Station Sampling Inlet Diagram

Figure 9-7. Hard Connection to Station Sampling Inlet

9.5.4.2. Soft Connection to Inlet Probe with a Teflon Bag

At sites where a hard connection cannot be secured, e.g., sites employing glass tubing for the inlet (Figure 9-8; right), the FS should use a Teflon® bag, fitted with a Teflon® union to allow connection the NPAP sample delivery line, to envelop the bell of the funnel (Figure 9-8; left). Secure the Teflon® bag in place with a zip tie or wire tie. If a Teflon® bag is used, no additional vents are needed on the NPAP sample delivery line; the surface contact between the Teflon® bag and the inlet tubing will not seal completely, effectively serving as a vent. This soft connection configuration will require additional conditioning with audit gas to reduce the time required for the monitoring station concentration measurement to become stable. Further guidance is provided in the sections that follow.

Figure 9-8. Soft Connection (left) to Station's Glass Tubing Sampling Inlet (right)

9.5.5. Communicating Audit Points to Site Operators

NPAP audits are single-blind performance evaluations where the concentrations of the test gas are known only to the FS and are blind to the site operator.

Once audit test gas concentration is acceptably stable (as described in Section 9.4), the FS notifies the site operator to provide a measurement when the site measurement is stable. The site operator is responsible for observing and judging when their station analyzer measurements are concentration stable. Once the site operator reports a measurement to the FS, the FS enters both the station measurement and the NPAP concentration measurement into the FBA Workbook. This process is repeated for each audit concentration

point. To minimize transcription errors, the FS should ask the site operator to confirm the site concentration measurements as entered in the FBA Workbook.

There may be situations in which a single audit concentration level (Table 9-1) is conducted more than once for a given pollutant during an audit. Generally, this occurs when more than one pollutant is being audited simultaneously and to reach the audit level for one pollutant the other ends up undergoing the same level multiple times. If a duplicate audit level is conducted for a given pollutant, the FS has two options:

1. During the second (or any thereafter) audit level test, do not request the site operator report the concentration for the pollutant in which the level was already tested (and reported). In this case, the FS never knows the site concentration and does not report the duplicated test result to the FBA Workbook.
2. The FS treats the second (or any thereafter) audit level test just like the first, in which the site operator reports the concentration to the FS, and it is documented on the FBA Workbook. In this case, **the FS must not choose one or the other result to report. Both results must be entered in the FBA Workbook** and subsequently reported to AQS.

Note, the FBA Workbook is designed to properly account for and format data for AQS upload when audit levels are challenged more than once (see Section 9.6).

9.5.6. Conducting CO, SO_2, and/or NO_2 FBAs

Prior to conducting the FBA, the pre-audit activities described in Sections 9.5.1 – 9.5.4 must be completed.

The following describes steps for conducting an audit for a single pollutant gas; however, FSs may conduct audits of multiple pollutant gases simultaneously.

As described in Section 9.5.2, the FS must ensure they are using the most up-to-date version of the FBA Workbook prior to every audit. The current version of the FBA Workbook is maintained on the NPAP Teams Channel and is routinely updated with the latest AQS data. The naming convention of the FBA Workbook includes the date it was most recently updated (e.g., *FBA_Workbook_v**2025-06-17**.xlsx*).

1. Open the FBA Workbook and enter any information not yet filled out on the **Monitor Information** tab. As much information as possible should be completed prior to visiting the site and discussed during the pre-audit conversations with the monitoring site employees. See Section 9.5.2 for details on entering this information.
2. Power on the gas calibrator and each of the flow rate transfer standards.
3. Zero/tare both the diluent and gas flow rate transfer standards.
4. Start flow through the system for at least one hour to warm up the system.

To ensure audits are conducted efficiently and are considerate of station operator time, auditors should conduct steps 1-4 sufficiently in advance where possible.

5. The flow rate transfer standards should be connected to and reporting data through the DAS. Ensure that data are logging properly.
6. Select the **Flow-Based Audit** tab in the FBA Workbook.
7. In the **NPAP Multiblend Cylinder Information** table (Figure 9-9), enter (or confirm the accuracy if already entered) the NPAP multiblend cylinder specifications based on information on the

cylinder's certification of analysis (COA). This must be the most recent certified concentrations and should never be concentrations as measured during a verification.

NPAP Multiblend Cylinder Information							
Cylinder	CO (ppm)	SO_2 (ppm)	NO (ppm)	NOx (ppm)	NO_2 Impurity (ppm)	Serial #	CGA VALVE
Superblend #1	465.1	15.48	30.34	30.32	-0.02	cbd1234	660

Figure 9-9. The *NPAP Multiblend Cylinder Information* Table in the Flow-Based Audit Tab

8. Determine the concentrations of the challenge gases to be provided to the monitoring station, minimally one concentration in each of Levels 5, 4, 3, and 2 and optionally Level 1 (if there is enough time and the station analyzer(s) can reach this lower level) for the criteria pollutant gases to be evaluated.

   Note: It is critical that there be remaining NO after performing GPT to produce NO_2, therefore FSs should select an NO concentration in the upper range of the audit concentration level such that the selected NO_2 concentration is lower than (by minimally 0.002 ppm) the selected NO concentration and still falls within the same audit concentration level, as practical. In some cases (e.g., Levels 2 and 3), it may be necessary to select an NO concentration in a level above the intended NO_2 concentration to ensure sufficient NO remains following GPT.

   The **Calibrator Setting & Estimated Concentration/Audit Level Calculator** table (Figure 9-10) can be used to determine the (1) gas calibrator diluent/gas flows and (2) both concentrations and estimated audit levels for each pollutant ($CO/SO_2/NO_2$) provided the desired concentration of a single pollutant. For a given audit point (individual row in the table), there are three user inputs in the calculator:

   a. Enter the desired concentration for only one of CO, SO_2, or NOx in the *Desired Final Concentration (ppm)* columns. The calculator will output an error message if more than one pollutant concentration is attempted to be entered (Figure 9-11).
   b. For NO_2 audits, enter the target O_3 concentration to be input in the gas calibrator during GPT in column *Gas Cal. O_3 Setting (ppm)*. Note, there is ideally a 1:1 conversion of O_3 to NO_2 during GPT. Therefore, this input is essentially the desired final NO_2 challenge concentration.
   c. Enter the desired total flow (typically ~16 LPM = 16,000 standard cubic centimeters per minute [SCCM]) in column *Desired Total Flow (SCCM)*.

   Provided these inputs, the calculator outputs the following:

   a. Gas calibrator diluent and gas flow values necessary to meet the desired input concentration are output in column *Estimated Flow to Meet desired Conc. (SCCM)*. Some calibrators offer both a 'concentration mode' and 'flow mode' while others only offer one option. In 'concentration mode', the final desired pollutant concentration and the multiblend cylinder concentration are input in the gas calibrator by the operator, from which the calibrator automatically sets the dilution and gas flows to meet the desired concentration. Conversely, in 'flow mode' the operator directly inputs the diluent and gas flows that the calibrator will operate. In 'flow mode', the operator must calculate what the

dilution and gas flows need to be to reach the desired concentration. This tool performs this calculation.

b. Estimated concentration values and audit levels for each of CO, SO_2, NO, and NO_2 are output in column *Estimated Concentration Provided Diluent/Gas Flows (ppm)*. These estimates are derived given the calculated diluent/gas flow and multiblend cylinder concentrations. This feature is useful if auditing multiple pollutants at the same time, in that it indicates each pollutant's audit level and if it falls within (cell turns green) or outside (cell turns red) the required audit levels (2-5). The desired concentration and total flow values can be adjusted until each of the pollutants being audited are within the desired level(s).

Calibrator Setting & Estimated Concentration/Audit Level Calculator														
Desired Final Concentration (ppm) Enter only 1 pollutant concentration per row.			Gas Cal. O_3 Setting (ppm) *NO_2 audit only*	Desired Total Flow (SCCM)	Estimated Flow to Meet desired Conc. (SCCM)		Estimated Concentration Provided Diluent/Gas Flows (ppm)				Estimated Audit Level (1-10) Provided Diluent/Gas Flows			
CO	SO_2	NOx			Diluent Flow	Gas Flow	CO	SO_2	NO	NO_2	CO	SO_2	NO	NO_2
	0.1000		0.0300	16000	15896.64	103.36	3.0045	0.1000	0.1660	0.0300	5	7	7	5
	0.0300		0.0090	16000	15968.99	31.01	0.9014	0.0300	0.0498	0.0090	4	5	5	4
	0.0100		0.0060	16000	15989.66	10.34	0.3005	0.0100	0.0136	0.0060	3	4	4	3
	0.0060		0.0030	16000	15993.80	6.20	0.1803	0.0060	0.0088	0.0030	2	3	4	2
	0.0035		0.0020	16000	15996.38	3.62	0.1052	0.0035	0.0049	0.0020	2	2	2	1

Figure 9-10. The *Calibrator Setting & Estimated Concentration/Audit Level Calculator* Table in the Flow-Based Audit Tab

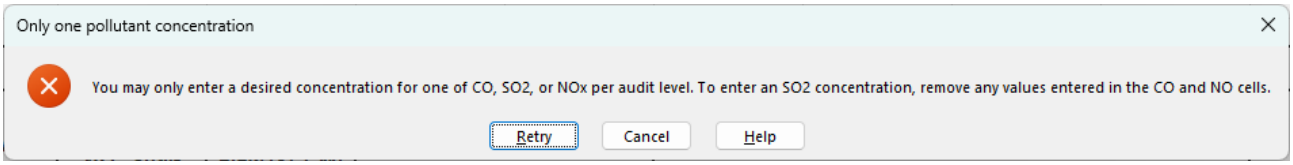


Figure 9-11. Example error message when more than one desired pollutant concentration is entered in the *Calibrator Setting & Estimated Concentration/Audit Level Calculator* table

9. Pre-Audit Zero Point:
    a. Program the gas calibrator to deliver zero air at ~16 LPM (or the given desired total audit flow rate, if different) and gas flow at 0 LPM, i.e., the target concentration for the given multiblend pollutant (CO, SO_2, or NO) and O_3 should be set to zero.
    b. If concurrently conducting an O_3 audit, ensure the verification manifold bypass 2-way valve is open and adjust the manifold needle valve (or regulator) such that the manifold rotameter vent reads ~0.4 LPM. Otherwise, ensure the 2-way valve is closed.
    c. Allow minimally 1 minute for the system to stabilize.
    d. Notify the site operator that they can report their measurement once it is concentration stable.
        i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 30 minutes for stability of the pre-zero audit point. See Section 9.4 for details on stability wait time requirements.
    e. In the **Audit Data Entry** table (Figure 9-12), in the *Pre Zero* audit point row of the table enter:

i. The pollutant(s) concentration reading (in ppm) from the site operator in column *Station Analyzer Concentration (ppm)*. Note, for a single pollutant audit only one column will require data entry for CO and SO_2 audits, whereas an NO_2 audit requires entry in three columns (one each for NO, NO_2, and NOx).

ii. The most recent 1-minute averaged flow rate (in **standard** cubic centimeters per minute [SCCM], where **standard temperature = 25 degrees Celsius (°C) and standard pressure = 760 millimeters of mercury [mmHg]**) from the diluent and gas flow rate transfer standards as output via the DAS in columns *Diluent Flow* and *Audit Gas Flow*, respectively.

iii. If applicable, enter the gas calibrator's certified (not verified) GPT diluent flow, i.e., "ozonator flow"[6], in column *GPT Diluent Flow*. This only applies for Teledyne T700 (or other) gas calibrators in which ozonator diluent flows occur and when using GPT (during NO_2 audits). When the cell is selected in the FBA Workbook, questions must be answered in various pop-ups, as illustrated in Figure 9-13, before entering the additional flow value. If this flow is not applicable, 0.00 SCCM, which is the default value, should be entered.

Audit Data Entry

Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)			Gas Cal. O_3 Setting (ppm)	Station Analyzer Concentration (ppm)				
		Diluent Flow	GPT Diluent Flow	Audit Gas Flow		CO	SO_2	NO	NO_2	NOx
1	Pre Zero	16001.00		0.00		-0.002	0.0000	0.0010	0.0240	0.0250
2	CO, SO2, NO/NOx Point #1									
3	NO2 Point #1									
4	CO, SO2, NO/NOx Point #2									
5	NO2 Point #2									
6	CO, SO2, NO/NOx Point #3									
7	NO2 Point #3		0.00							
8	CO, SO2, NO/NOx Point #4									
9	NO2 Point #4									
10	CO, SO2, NO/NOx Point #5									
11	NO2 Point #5									
12	Post Zero									
13	Post Zero ZAG Verification									

Notes:

Figure 9-12. Entering the Pre-Audit Zero Point Data into the *Audit Data Entry* Table on the Flow-Based Audit tab

[6] The "ozonator flow" refers to the rate of flow through the O_3 generator as controlled by a flow control assembly. This additional diluent flow is not measured by the flow rate transfer standards (in common configurations) and must be included in calculating the audit challenge gas concentrations.

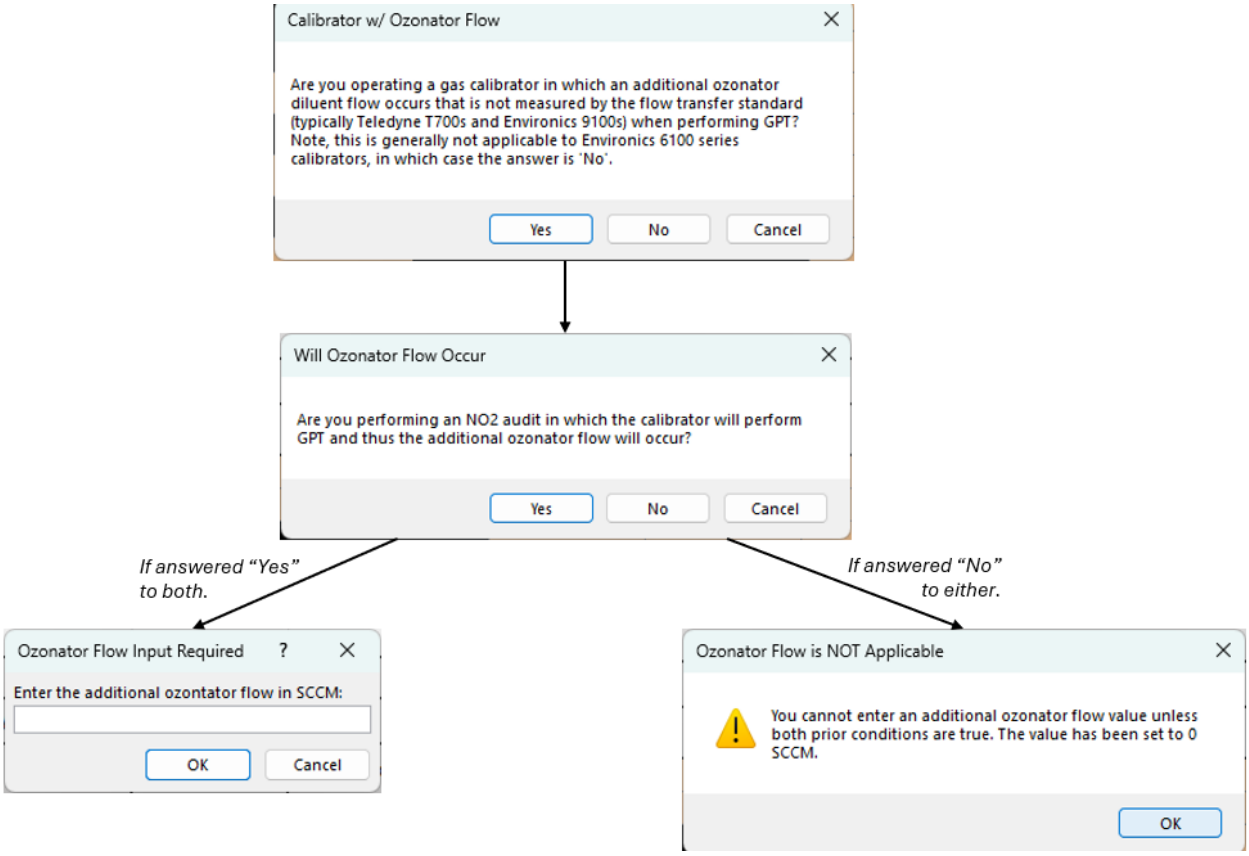


Figure 9-13. Flow Diagram of Pop-up Questions when Entering the Gas Calibrator's GPT Diluent Flow ("Ozonator Flow") into the *Audit Data Entry* Table on the Flow-Based Audit tab

10. Purging the Multiblend Cylinder Flow Path

    Refer to Figure 9-14 for purging the multiblend cylinder regulator flow path. Failure to properly purge the flow path will require extended site stabilization times.

    a. Open the multiblend cylinder regulator outlet valve.
    b. Open the multiblend cylinder tank valve.
    c. Adjust the regulator delivery pressure to 20 psi.
    d. Close the multiblend cylinder tank valve.
    e. Close the multiblend cylinder regulator outlet valve.
    f. Open the multiblend cylinder tubing connection purge valve until delivery pressure drops to 5 psi, then close the purge valve.
    g. Open the multiblend cylinder regulator outlet valve.
    h. Open the multiblend cylinder tank valve.
    i. Repeat Steps 10.d. through 10.h. four more times.

    Skip to step 13 for the next NO_2 audit instructions. Continue with steps 11-12 for CO/SO_2-specific instructions.

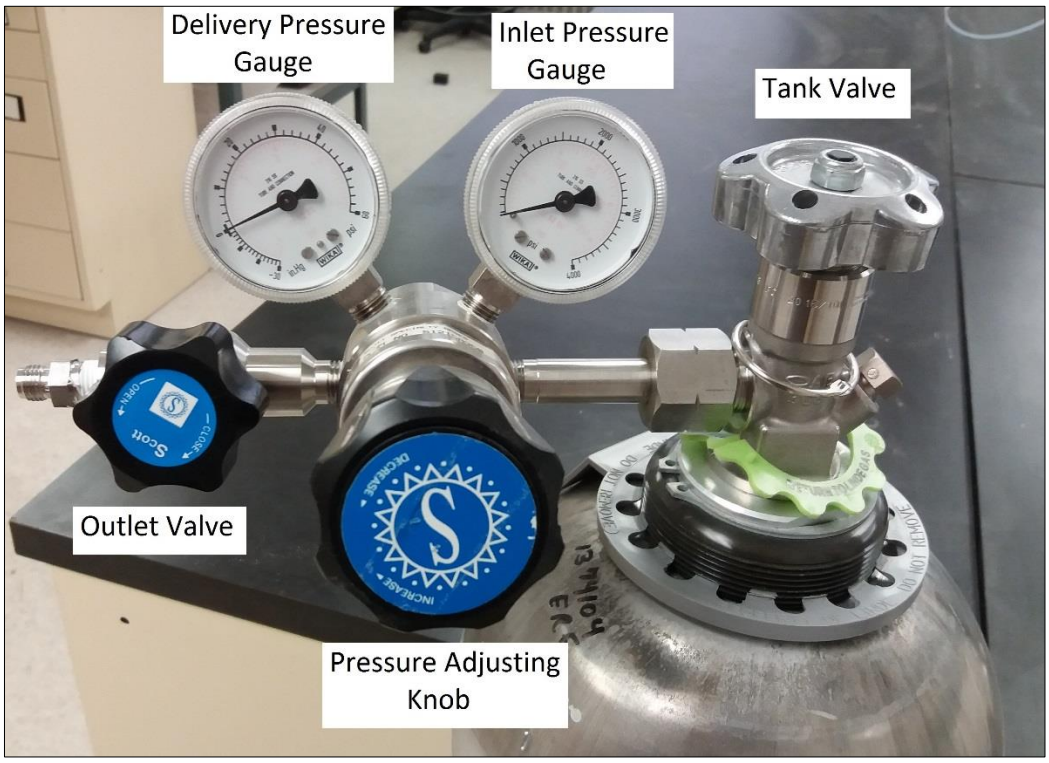


Figure 9-14. Compressed Gas Regulator

11. First (Level 5) CO or SO_2 Concentration Point (skip to step 13 for conducting NO_2 audits)
    a. Select a target audit concentration in the range of Level 5 and program it into the gas calibrator. As necessary, refer to the **Calibrator Setting & Estimated Concentration/Audit Level Calculator** (as described in Step 8 above) for the appropriate dilution and gas flow values.
    b. Allow minimally 10 minutes for the system to stabilize.
    c. Notify the site operator that they can report their measurement once it is concentration stable.
        i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 60 minutes for stability. See Section 9.4 for details on stability wait time requirements.
    d. In the **Audit Data Entry** table (Figure 9-15), for the *CO, SO2, NO/NOx Point #1* audit point row of the table enter:
        i. The CO and/or SO_2 concentration reading (in ppm) from the site operator in the appropriate *Station Analyzer Concentration (ppm)* columns.
        ii. The most recent 1-minute averaged flow rate (in **standard** cubic centimeters per minute [SCCM], where **standard temperature = 25 degrees Celsius (°C) and standard pressure = 760 millimeters of mercury [mmHg]**) from the diluent and gas flow rate transfer standards as output via the DAS in columns *Diluent Flow* and *Audit Gas Flow*, respectively.

Audit Data Entry

Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)			Gas Cal. O_3 Setting (ppm)	Station Analyzer Concentration (ppm)				
		Diluent Flow	GPT Diluent Flow	Audit Gas Flow		CO	SO_2	NO	NO_2	NOx
1	Pre Zero	16001.00		0.00		-0.002	0.0000	0.0010	0.0240	0.0250
2	CO, SO2, NO/NOx Point #1	15897.50		103.36		2.900	0.1010			
3	NO2 Point #1									
4	CO, SO2, NO/NOx Point #2									
5	NO2 Point #2									
6	CO, SO2, NO/NOx Point #3									
7	NO2 Point #3		0.00							
8	CO, SO2, NO/NOx Point #4									
9	NO2 Point #4									
10	CO, SO2, NO/NOx Point #5									
11	NO2 Point #5									
12	Post Zero									
13	Post Zero ZAG Verification									

Notes:

Figure 9-15. Entering the CO and SO2 Point #1 Data into the *Audit Data Entry* Table on the Flow-Based Audit tab

12. Second (Level 4) and Successive (Levels 3, 2, and optionally 1) CO or SO_2 Concentration Points
    a. After the first audit concentration point has been completed and the data are recorded in the **Audit Data Entry** table, repeat the process following step 11 above for successive audit points (*CO, SO2, NO/NOx Point #2/3/4/5*) in concentration Levels 4, 3, 2 and, if conditions permit (sufficient time remains and station analyzer detection limits permit), Level 1.
        i. Note, only 1 minute is minimally required to allow NPAP system stability for the second and successive audit points (as opposed to 10 minutes as shown in step 11.b for the first concentration point).
        ii. Similarly, FSs are only obligated to wait 30 minutes for site stability for the second and successive audit points (as opposed to 60 minutes as shown in step 11.c.i for the first concentration point).

Skip to step 15 for the next CO/SO_2 audit instructions. Steps 13-14 are NO_2-specific.

13. First (Level 5) NO/NO_2/NOx Concentration Point (refer to step 11 for conducting the first CO and/or SO_2 audit point)
    a. Select a target NO audit concentration in the upper range of Level 5 and program it into the gas calibrator. As necessary, refer to the **Calibrator Setting & Estimated Concentration/Audit Level Calculator** (as derived in Step 8 above) for the appropriate dilution and gas flow values.
    b. Allow minimally 10 minutes for the system to stabilize.
    c. Notify the site operator that they can report their measurement once it is concentration stable.
        i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 60 minutes for stability. See Section 9.4 for details on stability wait time requirements.
    d. In the **Audit Data Entry** table (Figure 9-16), for the *CO, SO2, NO/NOx Point #1* audit point row of the table enter:

i. The NO, NO_2, and NOx concentration readings (in ppm) from the site operator in the appropriate *Station Analyzer Concentration (ppm)* columns.

ii. The most recent 1-minute averaged flow rate (in SCCM, where **standard temperature = 25 °C and standard pressure = 760 mmHg**) from the diluent and gas flow rate transfer standards as output via the DAS in columns *Diluent Flow* and *Audit Gas Flow*, respectively.

Audit Data Entry

Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)			Gas Cal. O_3 Setting (ppm)	Station Analyzer Concentration (ppm)				
		Diluent Flow	GPT Diluent Flow	Audit Gas Flow		CO	SO_2	NO	NO_2	NOx
1	Pre Zero	16001.00		0.00		-0.002	0.0000	0.0010	0.0240	0.0250
2	CO, SO2, NO/NOx Point #1	15897.50		103.36		2.900	0.1010	0.1940	0.0000	0.1950
3	NO2 Point #1									
4	CO, SO2, NO/NOx Point #2									
5	NO2 Point #2									
6	CO, SO2, NO/NOx Point #3									
7	NO2 Point #3		0.00							
8	CO, SO2, NO/NOx Point #4									
9	NO2 Point #4									
10	CO, SO2, NO/NOx Point #5									
11	NO2 Point #5									
12	Post Zero									
13	Post Zero ZAG Verification									

Notes:

Figure 9-16. Entering the NO/NOx Point #1 Data into the *Audit Data Entry* Table on the Flow-Based Audit tab

e. Select the target NO_2 concentration within the Level 5 range that is less than the NO target concentration selected in step 13.a. Program the gas dilution calibrator to generate this concentration of ozone to begin the GPT to produce NO_2. *Note: Residual NO is required when performing GPT and the selected NO concentration should preferably be at least 30% higher than the selected NO_2 concentration*.

f. In the **Audit Data Entry** table (Figure 9-17) of the **Flow-Based Audit** tab, for the *NO2 Point #1* audit point enter the target ozone concentration (in ppm) in column *Gas Cal. O_3 Setting (ppm)*.

g. Allow minimally 1 minute for the system to stabilize.

h. Notify the site operator that they can report their measurement once it is concentration stable.

i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 30 minutes for stability. See Section 9.4 for details on stability wait time requirements.

i. In the **Audit Data Entry** table (Figure 9-17), for the *NO2 Point #1* audit point enter:

i. The NO, NO_2, and NOx concentration readings (in ppm) from the site operator in the appropriate *Station Analyzer Concentration (ppm)* columns.

ii. The most recent 1-minute averaged flow rate (in SCCM, where **standard temperature = 25 °C and standard pressure = 760 mmHg**) from the diluent and gas flow rate transfer standards as output via the DAS in columns *Diluent Flow* and *Audit Gas Flow*, respectively.

Audit Data Entry

Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)			Gas Cal. O_3 Setting (ppm)	Station Analyzer Concentration (ppm)				
		Diluent Flow	GPT Diluent Flow	Audit Gas Flow		CO	SO_2	NO	NO_2	NOx
1	Pre Zero	16001.00		0.00		-0.002	0.0000	0.0010	0.0240	0.0250
2	CO, SO2, NO/NOx Point #1	15897.50		103.36		2.900	0.1010	0.1940	0.0000	0.1950
3	NO2 Point #1	15897.30		103.40	0.030			0.1600	0.0310	0.2000
4	CO, SO2, NO/NOx Point #2									
5	NO2 Point #2									
6	CO, SO2, NO/NOx Point #3									
7	NO2 Point #3		0.00							
8	CO, SO2, NO/NOx Point #4									
9	NO2 Point #4									
10	CO, SO2, NO/NOx Point #5									
11	NO2 Point #5									
12	Post Zero									
13	Post Zero ZAG Verification									

Notes:

Figure 9-17. Entering the NO2 Point #1 Data into the *Audit Data Entry* Table on the Flow-Based Audit tab

14. Second (Level 4) and Successive (Levels 3, 2, and optionally 1) NO/NO_2/NOx Concentration Points
    a. After the first audit concentration point has been completed and the data are recorded in the **Audit Data Entry** table, do the following for successive audit points (*CO, SO2, NO/NOx Point #2/3/4/5* and *NO2 Point #2/3/4/5*) in concentration Levels 4, 3, 2 and, if conditions permit (sufficient time remains and station analyzer detection limits permit), Level 1.
    b. Set the ozone target concentration to zero on the gas dilution calibrator.
    c. Select an NO_2 audit concentration in the desired audit level toward the middle or lower portion of the concentration range and select an NO audit concentration in the upper portion of that level's concentration range greater than the desired NO_2 concentration. *Note: Residual NO is required when performing GPT and the selected NO concentration should preferably be at least 30% higher than the selected NO_2 concentration. To ensure there is sufficient residual NO after GPT in lower concentration audit levels (Levels 3, 2, and 1), it may require selecting an NO concentration in one or two audit levels above the audit level for the intended NO_2 concentration*.
    d. Allow minimally 1 minute for the system to stabilize.
    e. Notify the site operator that they can report their measurement once it is concentration stable.
        i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 30 minutes for stability. See Section 9.4 for details on stability wait time requirements.
    f. Repeat step 13.d-i.
15. Post-Audit Zero Point:
    a. Program the gas calibrator to deliver zero air at ~16 LPM (or the given desired total audit flow rate, if different) and gas flow at 0 LPM, i.e., the target concentration for the given multiblend pollutant (CO, SO_2, or NO) and O_3 should be set to zero.
    b. Allow minimally 1 minute for the system to stabilize.
    c. Notify the site operator that they can report their measurement once it is concentration stable.

i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 30 minutes for stability of the post-zero audit point. See Section 9.4 for details on stability wait time requirements.

d. In the **Audit Data Entry** table (Figure 9-18), in the *Post Zero* audit point row of the table enter:

i. The pollutant(s) concentration reading (in ppm) from the site operator in column *Station Analyzer Concentration (ppm)*. Note, for a single pollutant audit only one column will require data entry for CO and SO_2 audits, whereas an NO_2 audit requires entry in three columns (one each for NO, NO_2, and NOx)

ii. The most recent 1-minute averaged flow rate from the diluent and gas flow rate transfer standards as output via the DAS in columns *Diluent Flow* and *Audit Gas Flow*, respectively.

Audit Data Entry

Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)			Gas Cal. O_3 Setting (ppm)	Station Analyzer Concentration (ppm)				
		Diluent Flow	GPT Diluent Flow	Audit Gas Flow		CO	SO_2	NO	NO_2	NOx
1	Pre Zero	16001.00		0.00		-0.002	0.0000	0.0010	0.0240	0.0250
2	CO, SO2, NO/NOx Point #1	15897.50		103.36		2.900	0.1010	0.1940	0.0000	0.1950
3	NO2 Point #1	15897.30		103.40	0.030			0.1600	0.0310	0.2000
4	CO, SO2, NO/NOx Point #2	15969.00		31.00		0.950	0.0280	0.0600	0.0010	0.0580
5	NO2 Point #2	15968.99		31.01	0.009			0.0500	0.0090	0.0600
6	CO, SO2, NO/NOx Point #3	15989.80		10.33		0.350	0.0109	0.0201	0.0000	0.0200
7	NO2 Point #3	15989.70	0.00	10.32	0.006			0.0150	0.0057	0.0200
8	CO, SO2, NO/NOx Point #4	15993.70		6.20		0.189	0.0061	0.0120	0.0000	0.0121
9	NO2 Point #4	15993.70		6.21	0.003			0.0090	0.0031	0.0110
10	CO, SO2, NO/NOx Point #5	15996.30		3.60		0.110	0.0040	0.0070	0.0000	0.0070
11	NO2 Point #5	15996.31		3.60	0.002			0.0048	0.0020	0.0070
12	Post Zero	15999.10		0.00		0.001	0.0000	0.0000	0.0200	0.0200
13	Post Zero ZAG Verification									

Notes:

Figure 9-18. Entering the Post-Audit Zero Point Data into the *Audit Data Entry* Table on the Flow-Based Audit tab

16. Post-Audit ZAG Verification Zero Point (this verification is **not** required every audit; rather, complete minimally annually for each pollutant):

Note, during MVAs the ZAG performance is verified prior to every audit by comparing the NPAP CO analyzer measured CO levels in the (1) ZAG output and the (2) ZAG output routed through a Pd scrubber (ultrapure zero air from a high-pressure cylinder was previously used in place of the Pd scrubber). Given the NPAP setup for FBAs does not employ a CO analyzer, the ZAG performance verification method for FBAs utilizes either the station's monitor(s) or in-house instrumentation. Further, NO and Charcoal scrubbers have been added in-line with the Pd scrubber. Using this method, the ZAG performance is verified for CO, SO_2, and NO/NO_2. The following procedure describes how to perform the verification using the FBA Workbook during an NPAP audit utilizing the station's monitor(s). For ZAG performance verifications in which in-house instrumentation are used, utilize the ZAG Verification Workbook (available on the NPAP Teams Channel).

a. Adjust the scrubber bypass 3-way valve to route gas through the NO, Charcoal, and Pd scrubbers.

b. Program the gas calibrator to deliver zero air at ~16 LPM (or the given desired total audit flow rate, if different) and gas flow at 0 LPM, i.e., the target concentration for the given multiblend pollutant (CO, SO_2, or NO) and O_3 should be set to zero.
c. Allow minimally 1 minute for the system to stabilize.
d. Notify the site operator that they can report their measurement once it is concentration stable.
    i. It may take 10+ minutes for the site concentration to stabilize, but FSs are not obligated to wait more than 30 minutes for stability. See Section 9.4 for details on stability wait time requirements.
e. In the **Audit Data Entry** table (Figure 9-19), in the *Post Zero ZAG Verification* audit point row of the table enter:
    i. The pollutant(s) concentration reading (in ppm) from the site operator in column *Station Analyzer Concentration (ppm)*. Note, for a single pollutant audit only one column will require data entry for CO and SO_2 audits, whereas an NO_2 audit requires entry in three columns (one each for NO, NO_2, and NOx).
    ii. The most recent 1-minute averaged flow rate from the diluent and gas flow rate transfer standards as output via the DAS in columns *Diluent Flow* and *Audit Gas Flow*, respectively.

Audit Data Entry

Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)			Gas Cal. O_3 Setting (ppm)	Station Analyzer Concentration (ppm)				
		Diluent Flow	GPT Diluent Flow	Audit Gas Flow		CO	SO_2	NO	NO_2	NOx
1	Pre Zero	16001.00		0.00		-0.002	0.0000	0.0010	0.0240	0.0250
2	CO, SO2, NO/NOx Point #1	15897.50		103.36		2.900	0.1010	0.1940	0.0000	0.1950
3	NO2 Point #1	15897.30		103.40	0.030			0.1600	0.0310	0.2000
4	CO, SO2, NO/NOx Point #2	15969.00		31.00		0.950	0.0280	0.0600	0.0010	0.0580
5	NO2 Point #2	15968.99		31.01	0.009			0.0500	0.0090	0.0600
6	CO, SO2, NO/NOx Point #3	15989.80		10.33		0.350	0.0109	0.0201	0.0000	0.0200
7	NO2 Point #3	15989.70	0.00	10.32	0.006			0.0150	0.0057	0.0200
8	CO, SO2, NO/NOx Point #4	15993.70		6.20		0.189	0.0061	0.0120	0.0000	0.0121
9	NO2 Point #4	15993.70		6.21	0.003			0.0090	0.0031	0.0110
10	CO, SO2, NO/NOx Point #5	15996.30		3.60		0.110	0.0040	0.0070	0.0000	0.0070
11	NO2 Point #5	15996.31		3.60	0.002			0.0048	0.0020	0.0070
12	Post Zero	15999.10		0.00		0.001	0.0000	0.0000	0.0200	0.0200
13	Post Zero ZAG Verification	15998.50		0.00		0.000	-0.0005	0.0000	0.0100	0.0200

Notes:

Figure 9-19. Entering the Post Zero ZAG Verification Point Data into the *Audit Data Entry* Table on the Flow-Based Audit tab

f. Review the output in table **ZAG Performance Test Results** (Figure 9-20) to ensure the ZAG meets the performance requirements, i.e., the untreated ZAG concentration (Post Zero reading) must be no more than 0.020 ppm higher for CO and 0.001 ppm higher for SO_2/NO/NO_2 than the scrubbed/treated ZAG concentration (Post Zero ZAG Verification reading). Cells in the *Absolute Difference (ppm)* row turn red if the criterion is not met for a given pollutant. Corrective action must be taken if the verification fails for any pollutant. FSs must report failing results to their Regional NPAP Lead, who can provide further guidance. See Section 11.2.1 for details on conducting ZAG maintenance.

ZAG Performance Test Results*				
Pollutant	**CO**	**SO_2**	**NO**	**NO_2**
Absolute Difference (ppm)	**0.001**	**0.0005**	**0**	**0.01**
Acceptance Criteria (ppm)	0.02	0.001	0.001	0.001

* ZAG corrective action must be performed if results are unacceptable (cell highlighted red).

Figure 9-20. Example Results from the *ZAG Performance Test Results* Table on the Flow-Based Audit tab

17. After all audit points are complete and all entries in the **Audit Data Entry** table filled (Figure 9-19), subsequent output tables can be reviewed by the FS.
    a. The **SO_2 and CO Station Audit** Table (Figure 9-21) summarizes the results of the SO_2 and/or CO audit, and includes the NPAP challenge concentrations, station analyzer concentrations, percent differences, and the audit levels conducted. This table also indicates if all required audit levels (2-5) were tested.

SO_2 and CO Station Audit											
Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)		NPAP Challenge Concentration (ppm)		Station Analyzer Concentration (ppm)		Percent Difference: (Station - NPAP) / NPAP *100		Audit Level	
		Diluent Flow	Audit Gas Flow	CO	SO_2	CO	SO_2	CO	SO_2	CO	SO_2
1	Pre Zero	16001	0.0	0.0000	0.0000	-0.0020	0.0000				
2	CO & SO2 Point #1	15898	103.4	3.0044	0.1000	2.9000	0.1010	-3.5	1.0	5	7
4	CO & SO2 Point #2	15969	31.0	0.9011	0.0300	0.9500	0.0280	5.4	-6.7	4	5
6	CO & SO2 Point #3	15990	10.3	0.3003	0.0100	0.3500	0.0109	16.6	9.0	3	4
8	CO & SO2 Point #4	15994	6.2	0.1802	0.0060	0.1890	0.0061	4.9	1.7	2	3
10	CO & SO2 Point #5	15996	3.6	0.1046	0.0035	0.1100	0.0040	5.2	14.3	2	2
12	Post Zero	15999	0.0	0.0000	0.0000	0.0010	0.0000				
								All required levels (2-5) tested?		TRUE	TRUE

Figure 9-21. Example of the *SO_2 and CO Station Audit* Table after completing an audit

    b. The **NO and NOx Station Audit** Table (Figure 9-22) summarizes the results of the NO/NOx audit, and includes the NPAP challenge concentrations, station analyzer concentrations, and percent differences.

NO and NOx Station Audit											
Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)		NPAP Challenge Concentration (ppm)			Station Analyzer Concentration (ppm)			Percent Difference: (Station - NPAP) / NPAP *100	
		Diluent Flow	Audit Gas Flow	NO	NO_2	NOx	NO	NO_2	NOx	NO	NOx
1	Pre Zero	16001	0.0	0.0000	0.0000	0.0000	0.0000	0.0240	0.0250		
2	NO/NOx Point #1	15898	103.4	0.1960	-0.0001	0.1959	0.1940	0.0000	0.1950	-1.0	-0.5
4	NO/NOx Point #2	15969	31.0	0.0588	0.0000	0.0587	0.0600	0.0010	0.0580	2.0	-1.2
6	NO/NOx Point #3	15990	10.3	0.0196	0.0000	0.0196	0.0201	0.0000	0.0200	2.6	2.0
8	NO/NOx Point #4	15994	6.2	0.0118	0.0000	0.0117	0.0120	0.0000	0.0121	1.7	3.4
10	NO/NOx Point #5	15996	3.6	0.0068	0.0000	0.0068	0.0070	0.0000	0.0070	2.9	2.9
12	Post Zero	15999	0.0	0.0000	0.0000	0.0000	0.0000	0.0200	0.0200		

Figure 9-22. Example of the *NO and NOx Station Audit* Table after completing an audit

    c. The **NO_2 Station Audit** Table (Figure 9-23) summarizes the results of the NO_2 audit, and includes the NPAP challenge concentrations, station analyzer concentrations, percent differences, and the audit levels conducted. This table also indicates if all required audit levels (2-5) were tested.

NO_2 Station Audit														
Audit Point #	Audit Point Description	NPAP Transfer Standard Flow Readings (SCCM)		Gas Cal. O3 Setting (ppm)	NPAP Challenge Concentration (ppm)				Station Analyzer Concentration (ppm)			Percent Diff: (Station - NPAP) / NPAP *100	Audit Level
		Diluent Flow	Audit Gas Flow		NO original (Pre O3)	NO Remaining	NO_2	NOx	NO	NO_2	NOx		NO_2
2	Zero NO_2	15898	103.4	0.000	0.1956	0.1956	0.0000	0.1983	0.1940	0.0000	0.1950		
3	NO2 Point #1	15897	103.4	0.030	0.1956	0.1612	0.0343	0.2036	0.1600	0.0310	0.2000	-9.6	5
5	NO2 Point #2	15969	31.0	0.009	0.0601	0.0500	0.0101	0.0563	0.0500	0.0090	0.0600	-10.9	4
7	NO2 Point #3	15990	10.3	0.006	0.0197	0.0146	0.0051	0.0142	0.0150	0.0057	0.0200	11.8	3
9	NO2 Point #4	15994	6.2	0.003	0.0115	0.0085	0.0030	0.0047	0.0090	0.0031	0.0110	3.3	2
11	NO2 Point #5	15996	3.6	0.002	0.0065	0.0042	0.0023	0.0005	0.0048	0.0020	0.0070	-13.0	1
											All required levels (2-5) tested?		TRUE

Figure 9-23. Example of the *NO_2 Station Audit* Table after completing an audit

18. Audit Documentation Verification
    a. Preserve the audit data captured by the data logger by saving the acquired data file with the FS's annotations to the DAS PC. Annotations include indications of transfer standard flow rate stability for each audit point and the readings that were taken and recorded as the NPAP audit diluent and gas flows. These data files will be archived (see Section 10).
    b. Click the Save button in the upper left of the FBA Workbook to save the audit data. The FBA Workbook will be archived (see Section 10).

9.5.7. Post-Audit Steps

9.5.7.1. Disconnecting from the Site Inlet Probe

After all audit measurements have been collected and the data saved, the FS disconnects the audit delivery line from the station inlet and reels it onto the spool. The inlet probe is left in the as-found condition. Once the sample delivery line is no longer contaminating the ambient air near the station inlet, inform the site operator to turn the manifold blower back on (if applicable) and resume ambient air data collection recording, i.e., bring the channel online.

9.5.7.2. Shutdown of NPAP Audit Equipment

As soon as practical after the audit is complete, the NPAP audit equipment should be shut down in the following order:

1. Switch off the data logger/DAS.
2. Switch off the ZAG when the compressor cycle is off.
3. Once the pressure in the ZAG has dissipated to 5 psig or lower, switch off the gas calibrator.
4. Switch off the diluent and gas flow rate transfer standards.
5. Switch off the backup power supply and power conditioner.
6. Switch off the HVAC system (if equipped).
7. Switch off the main breaker which supplies power to the NPAP equipment.
8. Switch off the generator/disconnect from shore power (unplug from the air monitoring station's electrical outlets).
9. Cap the audit delivery line to prevent contamination from debris and water.
10. Close the multiblend gas tank regulator outlet valve.
11. Close the multiblend gas tank main valve.
12. Secure the regulator clamshell to protect the multiblend gas tank main valve during transport. **Never transport compressed gas tanks with unsecured regulator clamshells**.

9.5.7.3. Issuing the Audit Report

The FS will prepare and distribute an audit report to the agency following completion of the NPAP audit. For FBAs, the audit report is prepared within the FBA Workbook. The report can be prepared as a .PDF. To prepare an electronically signed PDF report, the FS will need to have established an electronic signature within Adobe Acrobat software on the FBA Workbook PC.

The FBA Workbook contains three (3) audit report tabs, one each for CO (tab **CO Report**), SO_2 (tab **SO2 Report**), and NO_2 (tab **NO2 Report**). Each report tab is not editable, and all content is autogenerated based on inputs from tabs **Monitor Information** and **Flow-Based Audit**. Figure 9-24 provides an example of a completed (unsigned) CO report.

To save one or more of the audit reports to PDF:

1. Select the report(s) tab(s) at the bottom of the Excel window. Note, to select more than one tab, click on the first report tab, then hold down the *Ctrl* key and select the other applicable report(s). Each of the report tabs should then be highlighted.
2. From the file tab (upper left of Excel window) select *Save As*. Alternatively, click *F12* on the keyboard.
3. Choose a descriptive file name when saving, including the AQS ID, pollutant(s) audited, and audit date in the name (e.g., *01-073-0023_ozone_2025-05-02*).
4. From the save as type dropdown, select *PDF (*.pdf)*.
5. Select the appropriate folder to save the file and click *Save*.
6. Be sure to open and electronically sign the PDF before providing to the agency.

National Performance Audit Program: Carbon Monoxide Audit Report					
NPAP Auditor:	Cooper Flagg	**Report Printed:**	2025-09-29	**Audit Date:**	2025-07-09

General Monitoring Site Information			
Region / State:	4 / North Carolina	**Station Manager:**	Mike Krzyzewski
PQAO Code:	0776	**AQS Latitude:**	35.856111
Site ID:	37-183-0014	**Measured Latitude:**	Not Reported
Site Name:	Millbrook School	**AQS Longitude:**	-78.574167
Address:	3801 SPRING FOREST RD.	**Measured Longitude:**	Not Reported

NPAP and Station Instrument Information				
Instrument:	NPAP Flow Transfer Standards			Station CO Analyzer
	High Range (Diluent)	Low Range 1 (Gas)	Low Range 2 (Gas)	
Manufacturer:	Alicat	Alicat		THERMO
Model:	MB20SLPM	MB100SCCM		48i-TLE
Serial Number:	382126	382125		abc-123
Calibration Date:	2024-06-25	2025-06-29		2025-06-04

CO Audit Results						
Audit Point	**Audit Level**	**Actual Conc. (ppm)**	**Station Conc. (ppm)**	**Percent Difference (%)**	**Absolute Difference (ppm)**	**Status***
Pre Zero	NA	0.0000	-0.0020			
CO Point #1	5	3.0044	2.9000	-3.5	-0.104	PASS
CO Point #2	4	0.9011	0.9500	5.4	0.049	PASS
CO Point #3	3	0.3003	0.3500	16.6	0.050	FAIL
CO Point #4	2	0.1802	0.1890	4.9	0.009	Informational Pass
CO Point #5	2	0.1046	0.1100	5.2	0.005	Informational Pass

* Acceptance criterion for audit levels 3-10 is a percent difference within ±15%. For levels 1-2, if either the percent difference is within ±15% or if the absolute difference is within ± 0.030 ppm the level is passing. Note, only results from levels 3-10 are considered for site audit results. Levels 1-2 results are provided for informational purposes only and should not be considered in the overall audit pass/fail status.

Signatures			
Auditor Name:	Cooper Flagg	Station Operator Name:	
Auditor Signature:		Station Operator Signature:	

Automated and Manual Comments
This is a test comment.

Figure 9-24. Example of a CO Audit Report from the CO Report tab of the FBA Workbook

9.6. Uploading FBA Results to AQS

FBA results must be manually uploaded to AQS as transaction strings. It is the responsibility of the Regional Lead to perform the upload; however, the task may be delegated to FSs or other appropriately trained staff. **Individual audit results must be uploaded to AQS within 30 days from the date the audit was performed**.

To upload data to AQS, users require both an AQS and Environmental Information Exchange Network account:

- AQS account: Contact your EPA Regional AQS contact to complete the registration process. More information is available at https://www.epa.gov/aqs/aqs-user-registration.
- Environmental Information Exchange Network: To register, complete the form at https://enservices.epa.gov/Register.aspx.

Table 9-3 provides a description of each parameter included in the transaction string and where in the FBA Workbook the parameters are input or provided. Tab **AQSTransactions** of the FBA Workbook automatically generates the AQS transaction strings needed for AQS upload. This tab consists of three tables:

- **AQS Transaction Parameters**: This table is auto-populated based on user inputs in tabs **Monitor Information** and **Flow-Based Audit**. Each column is an individual parameter included in the transaction string (see Table 9-3). Each row is an individual pollutant (either CO, SO_2, or NO_2) and assessment number combination. For each pollutant, up to three autogenerated transactions may exist, which are distinguished with a unique *Assessment Number* ("1", "2", or "3"). For most FBAs, only the first transaction, i.e., *Assessment Number* = "1", will exist for each pollutant. Only when the same audit level is tested more than once for a given audit will the second (*Assessment Number* = "2") or third (*Assessment Number* = "3") transaction be created; otherwise, the row is blacked out. When the same level is tested multiple times for a given pollutant, it usually happens when multiple pollutants are audited simultaneously, and several audit points at the same level for one pollutant are necessary to meet all the required audit levels for the other pollutant. **Note, if a duplicate audit level is conducted for a given pollutant and the site operator provides their instrument concentration result to the FS, the FS must not choose one or the other to report. Both results must be reported in the FBA Workbook and subsequently reported to AQS (see Section 9.5.5 for more details)**.
- **Final AQS Transaction Strings**: The final pipe-delimited transaction strings ready for AQS upload. This table is auto-populated and not editable.
- **Error Code Table**: Defines various output errors (red highlighted cells) and warnings (orange highlighted cells) for any parameter(s) in the **AQS Transaction Parameters** table. Any transaction in red cannot undergo an AQS upload attempt (the upload will fail) and the issue must be rectified before proceeding.

The *Monitor Method Code* included in the AQS transaction string is generated from records in AQS (AMP500 Transaction Type MM) for the given monitor and audit date (automatically generated in the **Station Monitor Information** table of tab **Monitor Information**). The transaction string will only include the manually input method code (manually input in the **Station Monitor Information** table of tab **Monitor Information**) if no method code is associated with the monitor/audit date combination in AQS. The latter may result in an AQS upload error and should be investigated by the Regional Lead (or designee). Cells/transactions in tab **AQSTransactions** are highlighted orange when the manually input method code is being used in the transaction. Further, autogenerated notes regarding method code discrepancies/issues are provided in the *Automated and Manual Comments* section of tabs **CO Report**, **SO2 Report**, and **NO2 Report**.

Table 9-3. AQS Transaction Parameters and FBA Workbook links for NPAP FBA Upload

Parameter	Description	FBA Workbook tab(s) and table reference
Transaction Type	Specifies which batch transaction is being processed by the batch load software (i.e., which tables and columns will be updated with the data in the delimited fields).	NA. The entry will always be "QA".
Action Indicator	Indicates the data manipulation action to be performed by the transaction.	NA. The entry will always be "I" for new records.
Assessment Type	Indicates the specific QA assessment associated with the transaction.	NA. The entry will always be "NPAP".
Performing Agency	Agency Code of organization performing assessment.	Tab **Monitor Information**; Table **General Audit Information**.
State Code/Tribal Indicator	A Federal Information Processing Standards (FIPS) code that identifies one of the 50 states, U. S. territories, Washington, DC, or foreign countries.	Tab **Monitor Information**; Table **Site Information**.
County Code/Tribal Code	A FIPS code that identifies a county, or equivalent geo-political entity, such as parish or independent city. For foreign countries, it identifies the geo-political equivalent to U. S. states, such as Mexican states or Canadian provinces.	Tab **Monitor Information**; Table **Site Information**.
Site Number	A numeric identifier that uniquely identifies each air monitoring site within a county or tribal area.	Tab **Monitor Information**; Table **Site Information**.
Parameter Code	The code assigned to the parameter measured by the monitor. For NPAP FBAs, this should be one of 42401 (SO_2), 42602 (NO_2), or 42101 (CO).	NA. The first three, middle three, and last three rows of the AQS Transaction Parameters table will always be the parameter code for CO (42101), SO_2 (42401), and NO_2 (42602), respectively.
POC	An identifier used to distinguish between multiple monitors at the same site that are measuring the same parameter.	Tab **Monitor Information**; Table **Station Monitor Information**.
Assessment Date	Date that the NPAP audit was performed.	Tab **Monitor Information**; Table **General Audit Information**.
Assessment Number	A unique number associated with an assessment performed at a site on a given day. Value should be "1" unless additional assessments of the same type are performed. For NPAP, if the same audit level is tested more than once during the day/site audit, additional assessment numbers beyond "1" will be used.	NA. This is automatically generated in the transaction string code based on the number of duplicate audit levels tested. The first pollutant entry will always be "1", with subsequent duplicate level pollutant audits being "2" and "3".
NPAP Type	An identifier to distinguish if the audit was conducted TTP or BOA.	Tab **Monitor Information**; Table **General Audit Information**.

Parameter	Description	FBA Workbook tab(s) and table reference
Monitor Method Code	The sampling methodology of the monitor being assessed.	Tab **Monitor Information**; Table **Station Monitor Information**.
Assessment Method Code	For MVAs, this is the method code of the NPAP CO analyzer. Given no CO analyzer is used for FBAs, method code "FBA" has been created in AQS to distinguish FBAs (utilizing the tank gas certified concentration and flow standards' flow rates) and must be used for this field when conducting FBAs.	NA. The entry will always be "FBA".
Reported Unit	Unit of measure associated with the reported concentration, mass, or flow value.	NA. The entry will always be "007", representing parts per million (ppm).
Level 1-10 Monitor Concentration	The concentration value provided by the monitor being assessed at levels 1-10. Note, this includes 10 separate field entries in the transaction.	Tab **Flow-Based Audit**; Table **SO_2 and CO Station Audit** (CO and SO_2), and **NO_2 Station Audit** (NO_2). The given level (1-10) is automatically determined based on the NPAP/assessment concentration.
Level 1-10 Assessment Concentration	The value of the known gas standard, i.e., NPAP, concentration in audit levels 1-10. Note, this includes 10 separate field entries in the transaction.	Tab **Flow-Based Audit**; Table **SO_2 and CO Station Audit** (CO and SO_2), and **NO_2 Station Audit** (NO_2). The given level (1-10) is automatically determined based on the NPAP/assessment concentration.

The following steps describes how to upload the FBA Workbook autogenerated transaction strings to AQS. **Note, any transaction highlighted red will fail to upload to AQS as this is missing critical information or includes method code or POC values that are not in AQS for that site and date. These errors must be corrected before attempting an AQS upload. Any transaction highlighted orange may fail to upload and should also be reviewed and updated, as necessary.**

1. From the **AQSTransactions** tab of the FBA Workbook, click the "Export AQS Transaction Strings to *.txt" button. From the "Save As Text File" popup, create a file name and save to a folder on your computer.
    a. Alternatively, to save without the Excel Macro button:
        i. Select and copy the AQS transaction strings output in the **Final AQS Transaction Strings** table.
        ii. Paste the transaction strings into a text editor application (e.g., Notepad or Wordpad).
        iii. Remove any extra line breaks between individual transactions in the text editor. Extra line breaks will exist if you copy over empty rows between transactions.
        iv. Once all transactions are in the text editor that you want to convert, save it as a text file (*.txt).
2. Log into the AQS GUI.

a. The application can be accessed via https://aqs.epa.gov/aqs/.
b. After clicking the link, a JNLP file (*.jnlp) will be downloaded. Save it anywhere on your computer.
c. Once downloaded, open the application.
d. From the login screen, ensure the database is “aqsprod” and click “Connect”.

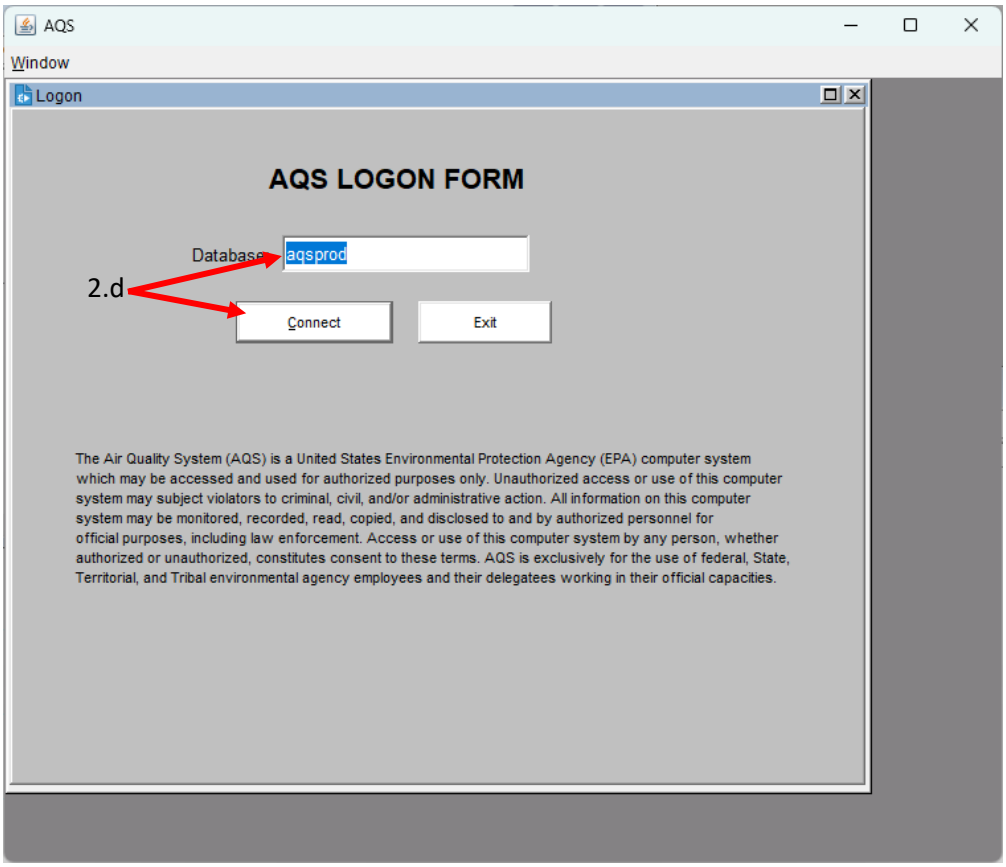


Figure 9-25. The AQS Login Screen

3. Once logged in, on the first screen:
   a. Click the “Screening Group Access” radio button. From the “Select a Screening Group” popup, select the appropriate access for your Region.
   b. Click “OK”. An EPA logo will then appear.
   c. Click the “Batch” link on the top ribbon.

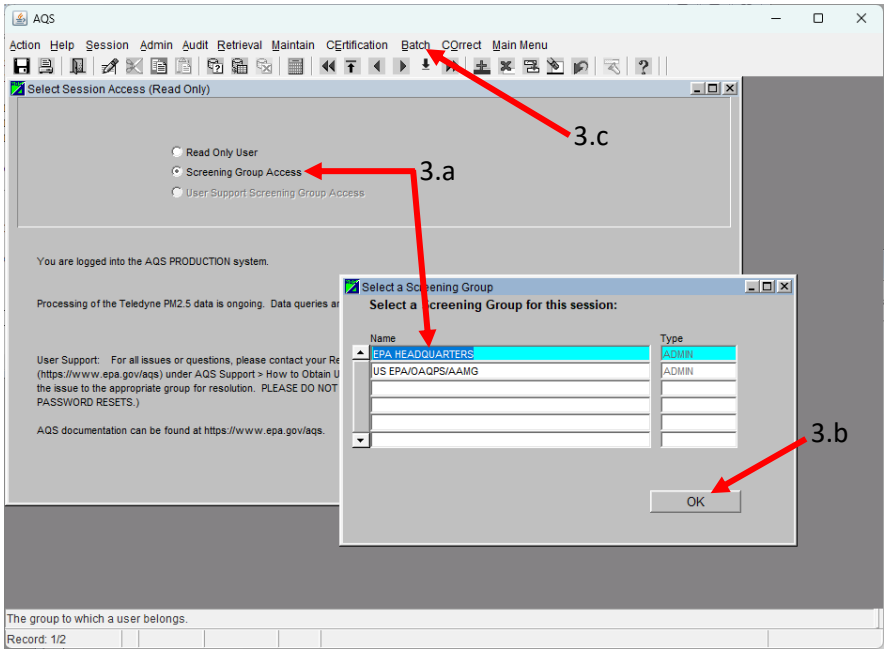


Figure 9-26. Selecting the Screening Group Access in AQS

4. From the “Batch” screen, click “Goto ENSC”.

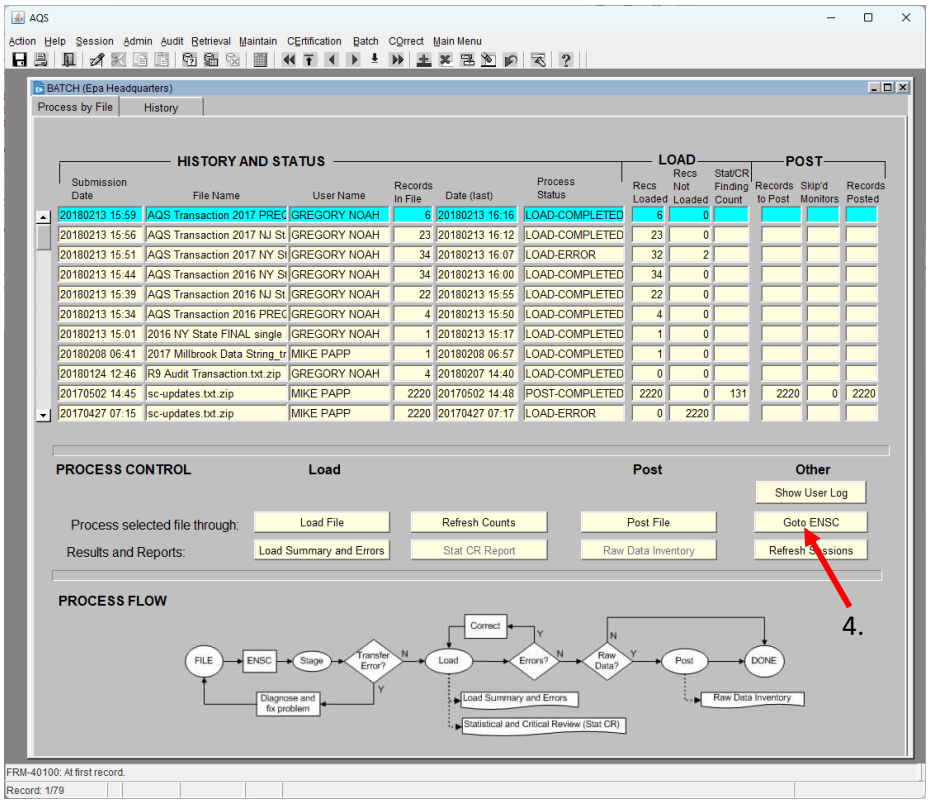


Figure 9-27. Accessing the Environmental Information Exchange Network within AQS

5. A web browser will open to the Environmental Information Exchange Network login page[7]. Log in by entering your exchange network Username and Password and click “Login”.

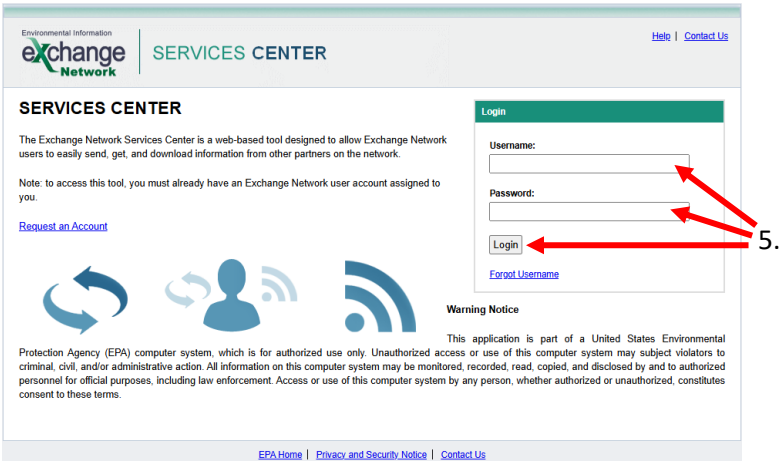


Figure 9-28. The Environmental Information Exchange Network Login Screen

6. Once logged in, from the Home tab, select “GO” from the “MY SERVICES CENTER” box.

Figure 9-29. Accessing the My Service Center within the Environmental Information Exchange Network

7. On the next screen:
    a. Under the “Send Info” tab, type “AQS” in the “Find a Service” box.
    b. Click the “Service Directory” radio button.
        i. Note, selecting the “Make this my Start page” checkbox will allow you to skip this step in the future.
    c. Click the green “Find” button.

[7] The Environmental Information Exchange Network login page can be accessed at the following link: https://enservices.epa.gov/login.aspx.

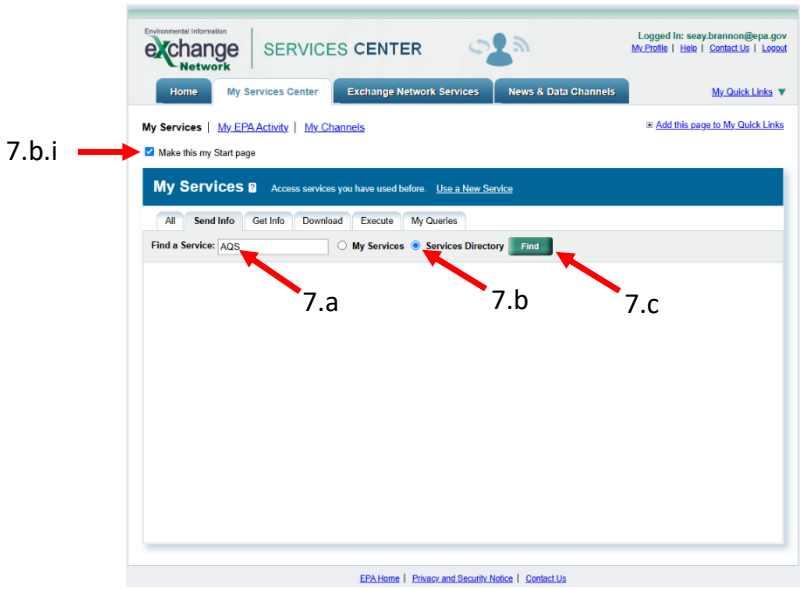


Figure 9-30. Querying the My Services Directory for AQS

8. On the next screen, select the "Send Info" link on the Service Name = "AQS Submit" line.

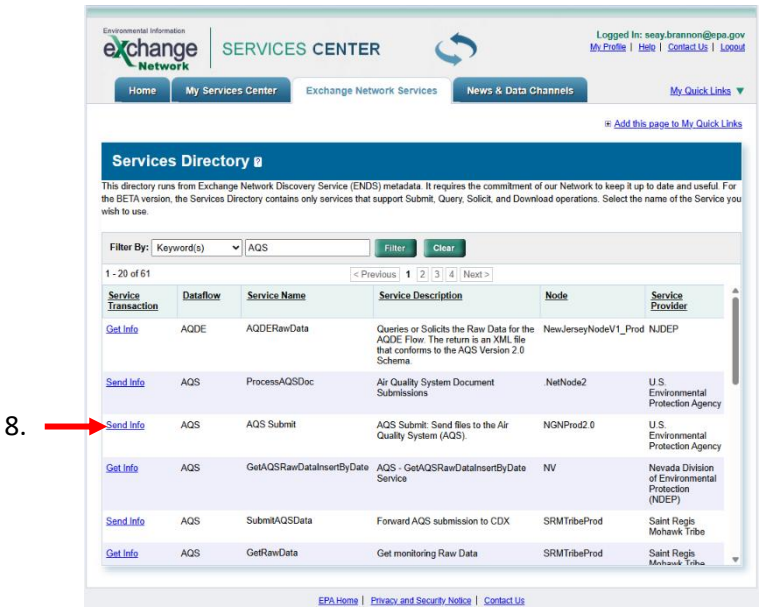


Figure 9-31. Selecting the AQS Submit service name

9. On the "Express Request: AQS Submit" screen, complete the following fields:
   a. Select the "Choose File" button to navigate to and select the transaction string text file saved in step 4.
   b. Enter Sender's Email Address to Notify of Transaction Status Changes: Enter your email address (optional).
   c. AQS User ID: Enter you AQS User ID.
   d. Screening Group: From the dropdown, select your screening group (likely Region 1 – Region 10).

e. File Type: From the dropdown, select “FLAT”.
f. Final Processing Step: From the dropdown, select “Post”.
g. Stop On Error: From the dropdown, select “No”.
h. Click the “SEND DATA” button.

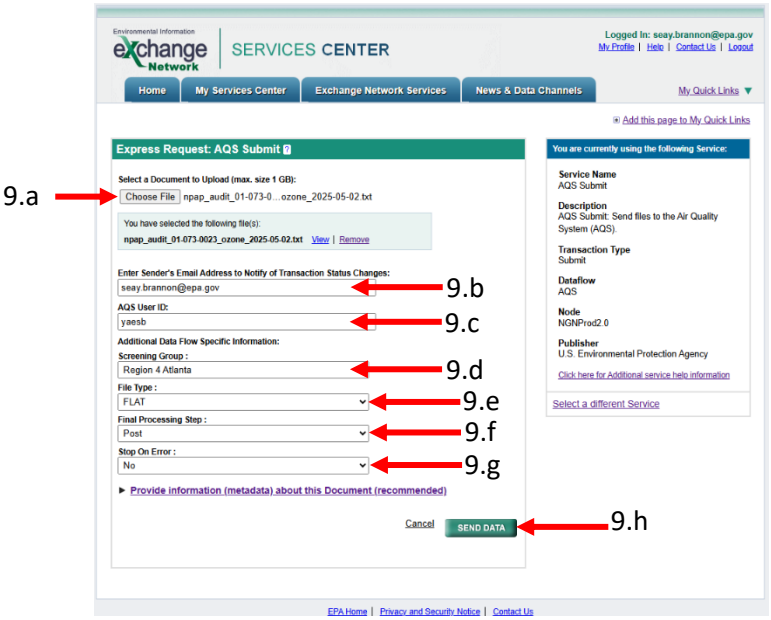


Figure 9-32. The Express Request: AQS Submit Screen

10. After sending the data, the subsequent screen will confirm the data request has been received. Note, it may take a few minutes. To confirm the upload was successful, select the “View the Status of this request in My Activity” link.

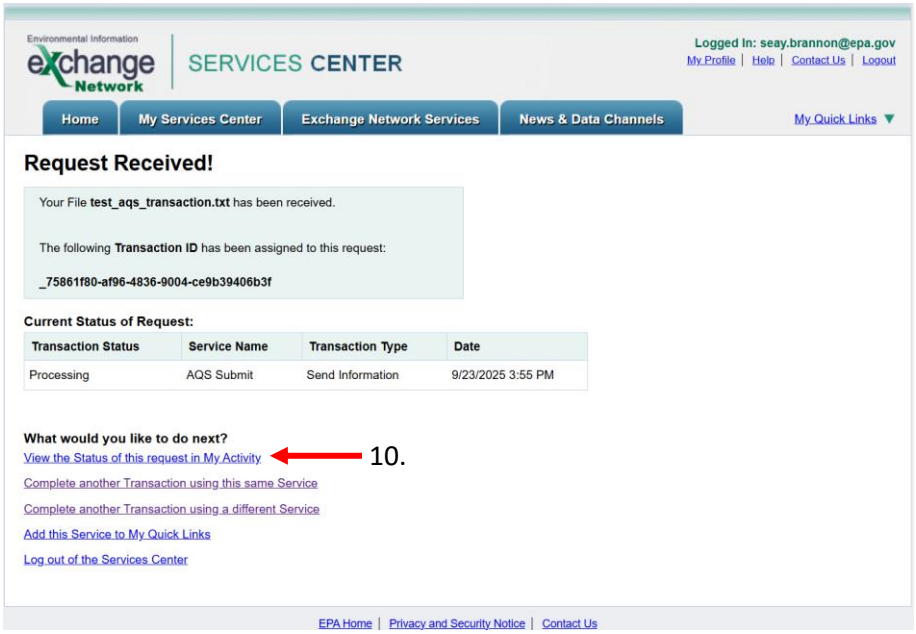


Figure 9-33. Screen indicating confirmation that data request is received

11. On the "My EPA Activity" screen, the status of the submission can be viewed under the "Transaction Status" column for the given transaction. An email will also be provided containing the transaction's final status. **Confirm that all data rows were successfully loaded**.
    a. **Note, if errors do exist with the load continue with steps 12-19 below.**

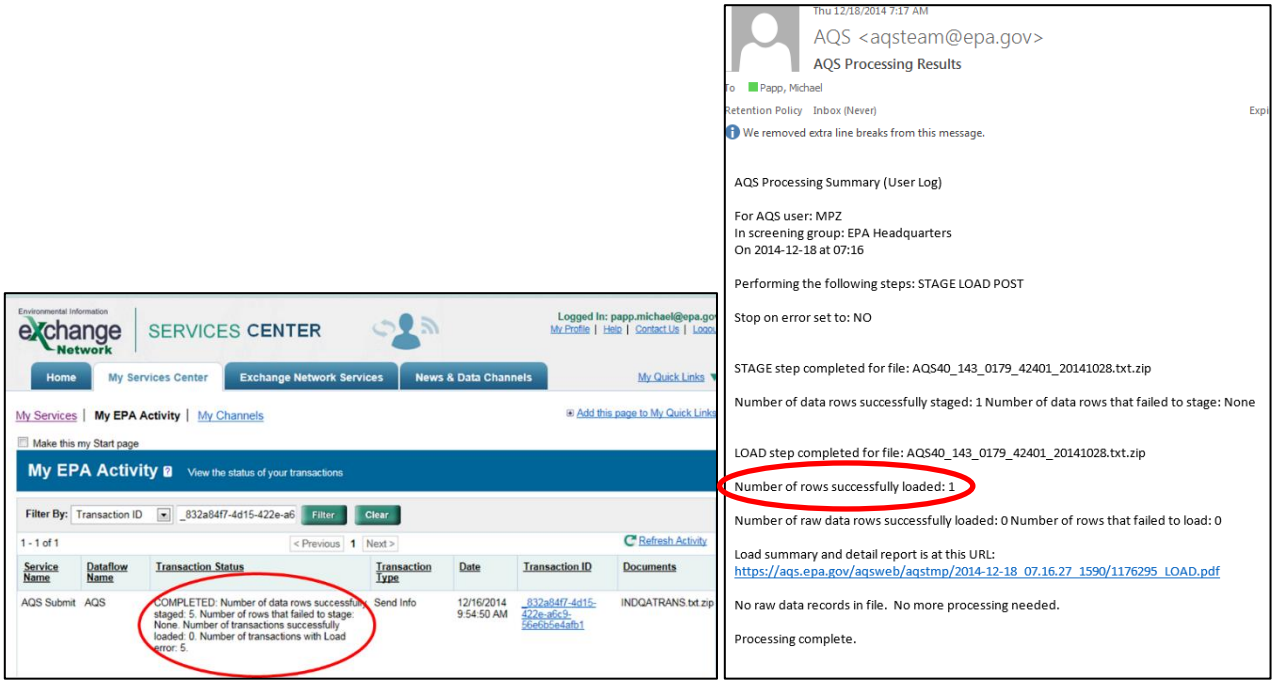


Figure 9-34. Transaction status screen (left) and email (right)

12. **If errors exist with the transaction load**, return to the Batch screen in AQS (by click the "Batch" link on the top ribbon).
    a. If the given file does not appear in the list, click "Refresh Session" until the file has loaded.
    b. Check the "Recs Not Loaded" column. The number of individual transactions that failed the upload will be shown in this column. The subsequent steps detail the procedure to correct and reupload these records.

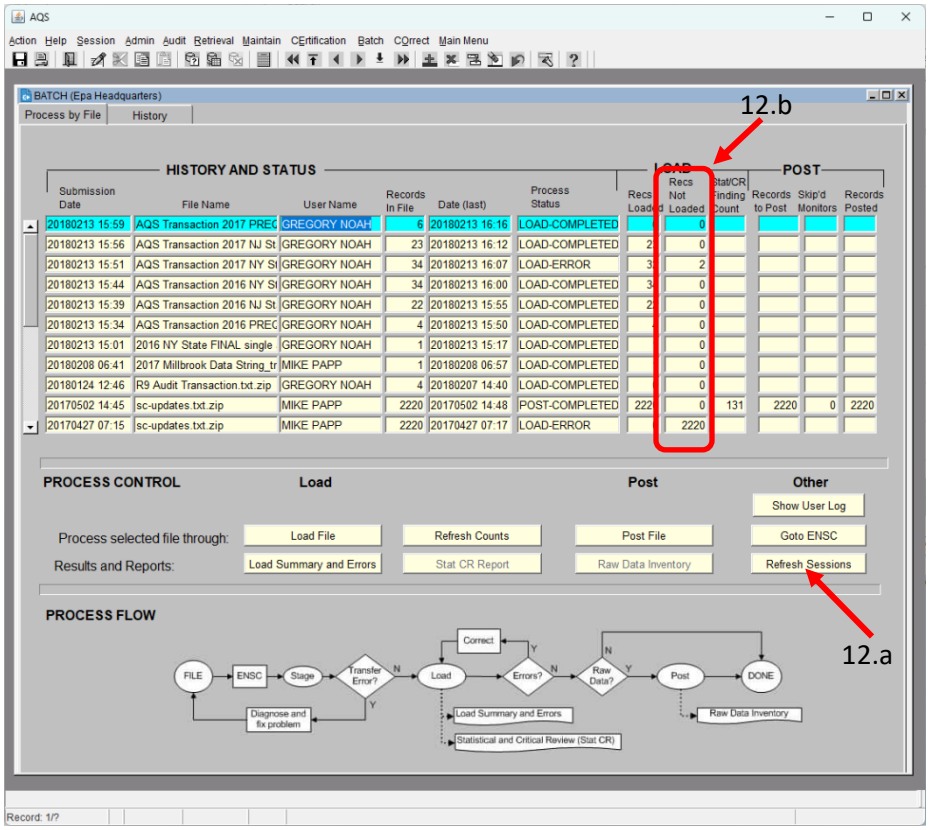


Figure 9-35. Reviewing transaction records that failed to load to AQS

13. From the top ribbon in AQS, click the "COrrect" tab. From the dropdown hover over "QA Transactions", then select "NPAP" from the additional dropdown.

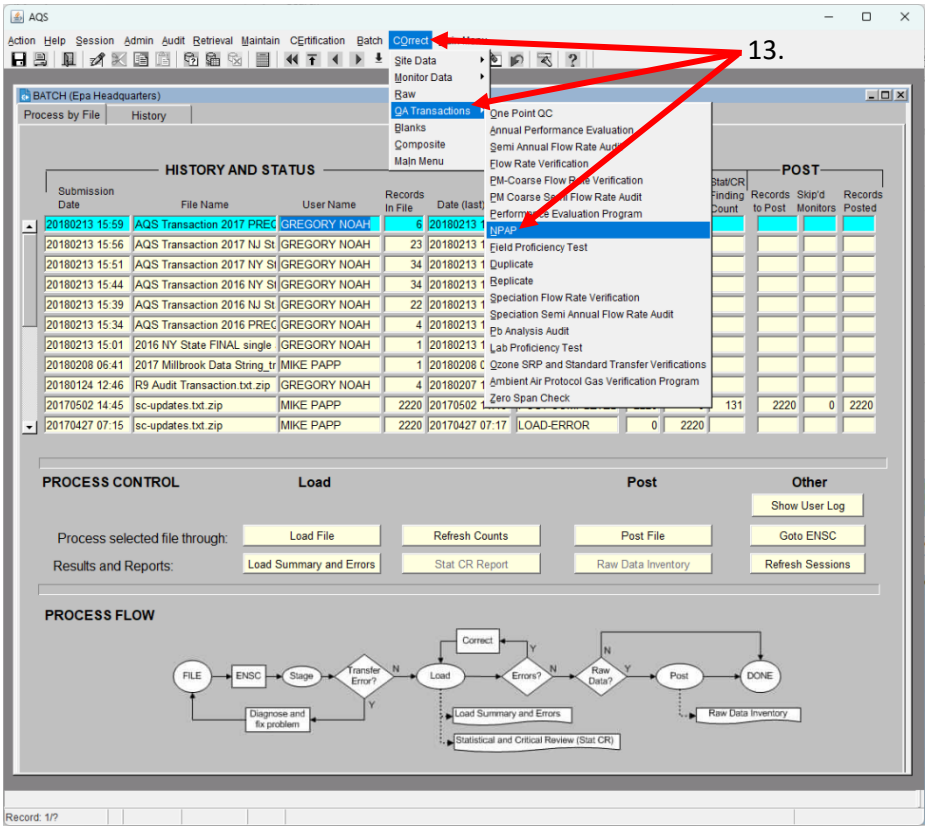


Figure 9-36. Navigating to the NPAP correction page in AQS

14. In the GENERIC CORRECT FORM:
    a. Highlight the row containing the transaction in the “Select file to view errors:” table.
    b. Click the “Get QA Data for Selected File” button. This will populate the middle “NPAP” table.
    c. Click on a given row in the “NPAP” table. This will populate the lower “ROW ERRORS” table, providing the error code and message.

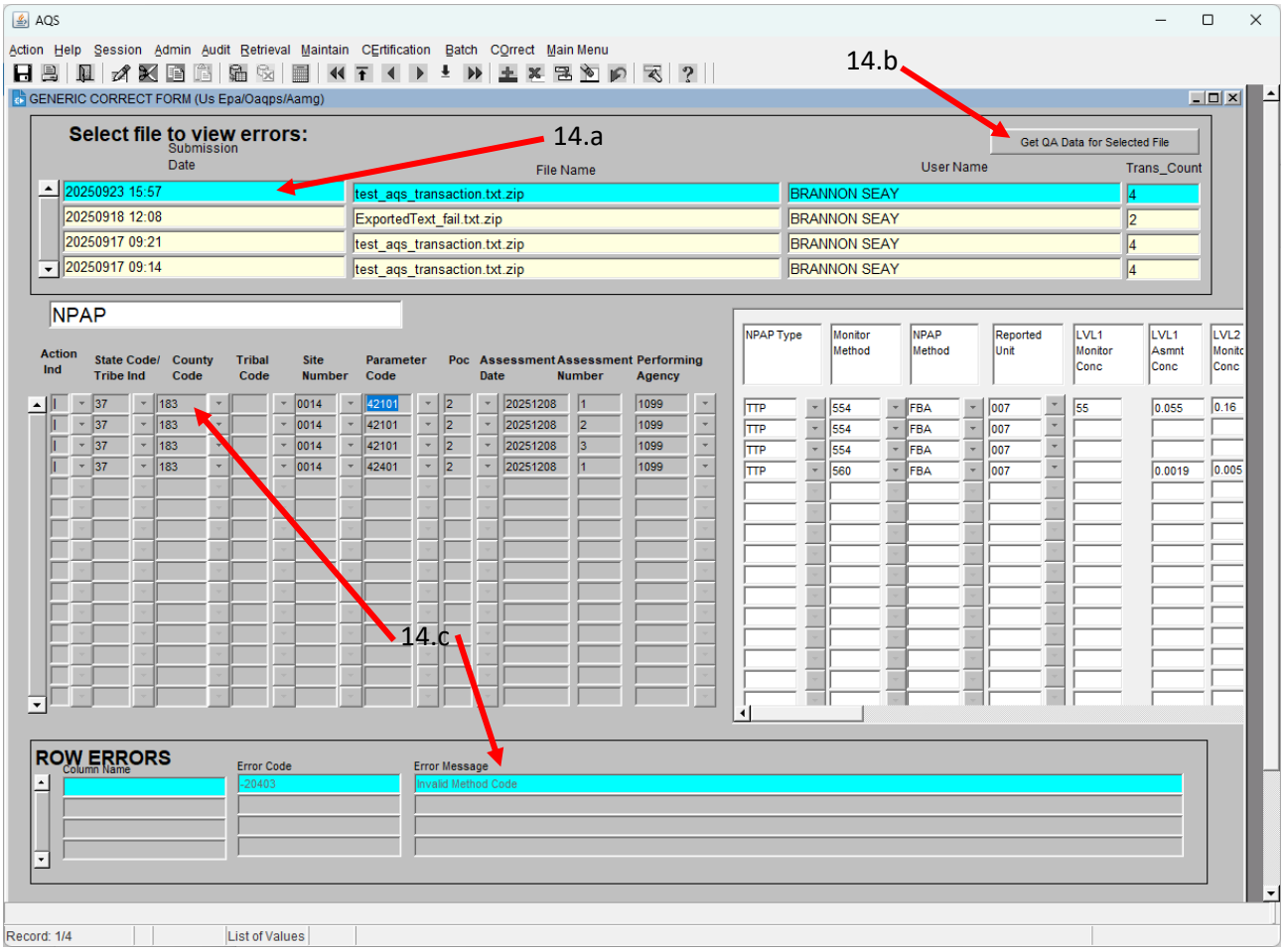


Figure 9-37. Reviewing transactions requiring correction and the associated error(s)

15. Based on the given error code/message, take necessary corrective action. In some cases, fixing the error may require the audited agency to update AQS metadata, e.g., the monitor method code.
16. After the required correction is determined, click on the dropdown next to the column with the error, select the correct code/value, and click “OK”.

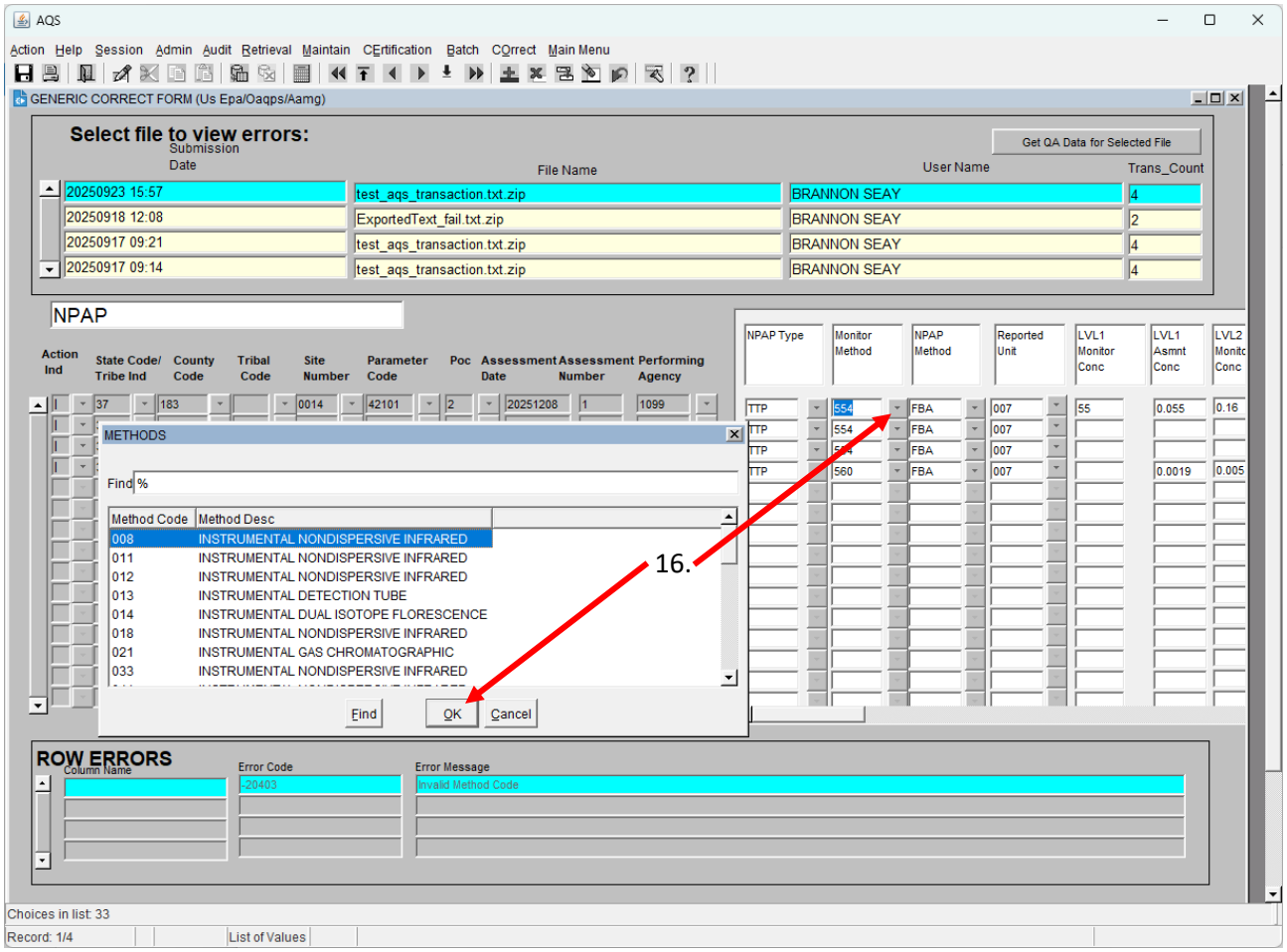


Figure 9-38. Making the correction in AQS

17. From the top ribbon, click the "Action" tab. From the dropdown select "Save".

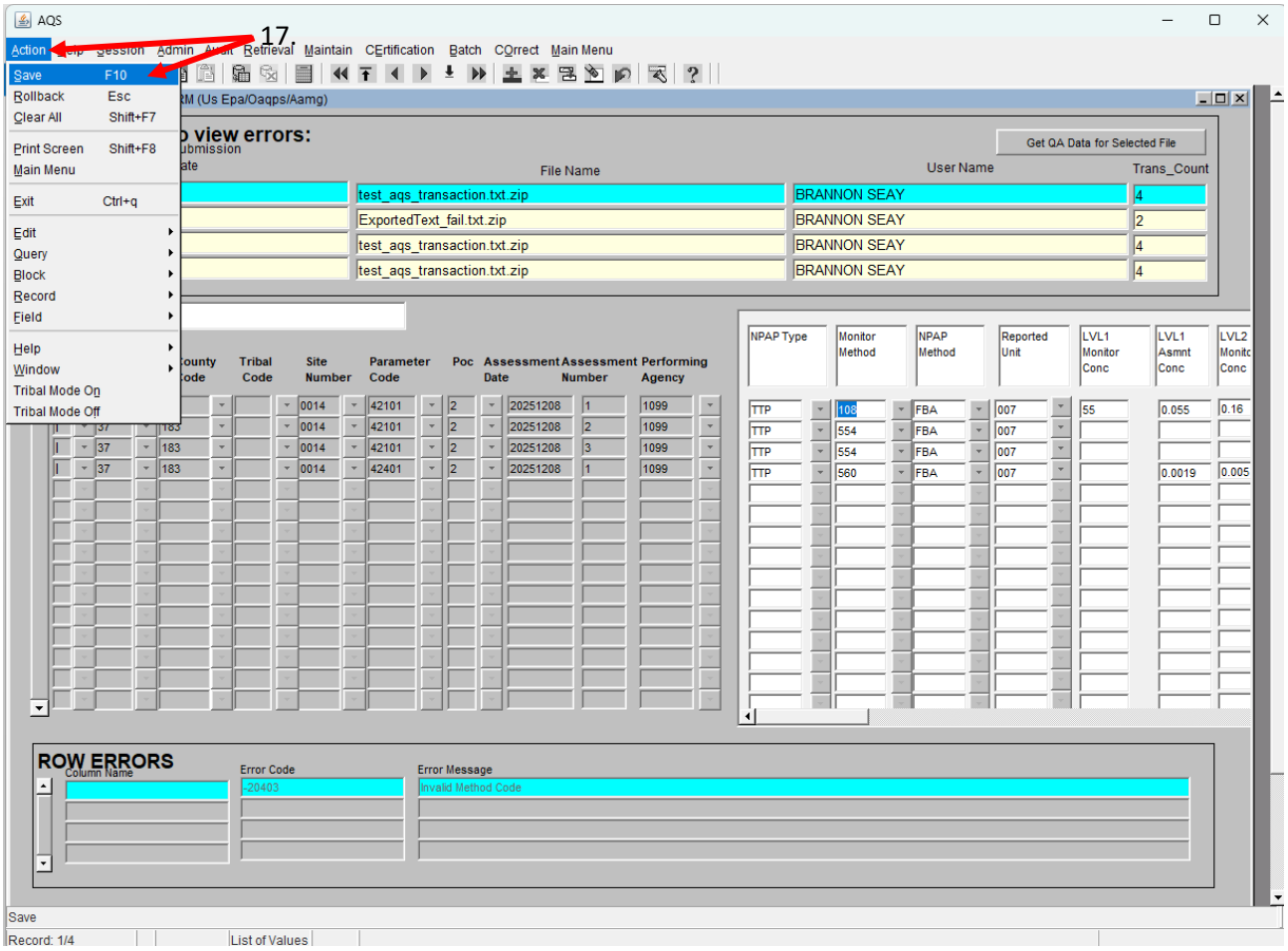


Figure 9-39. Saving the corrected data in AQS

18. Load the now corrected data:
    a. Return to the batch page on AQS by clicking the “Batch” link on the top ribbon.
    b. From the Batch screen highlight the file that you just corrected.
    c. Click “Load File”.

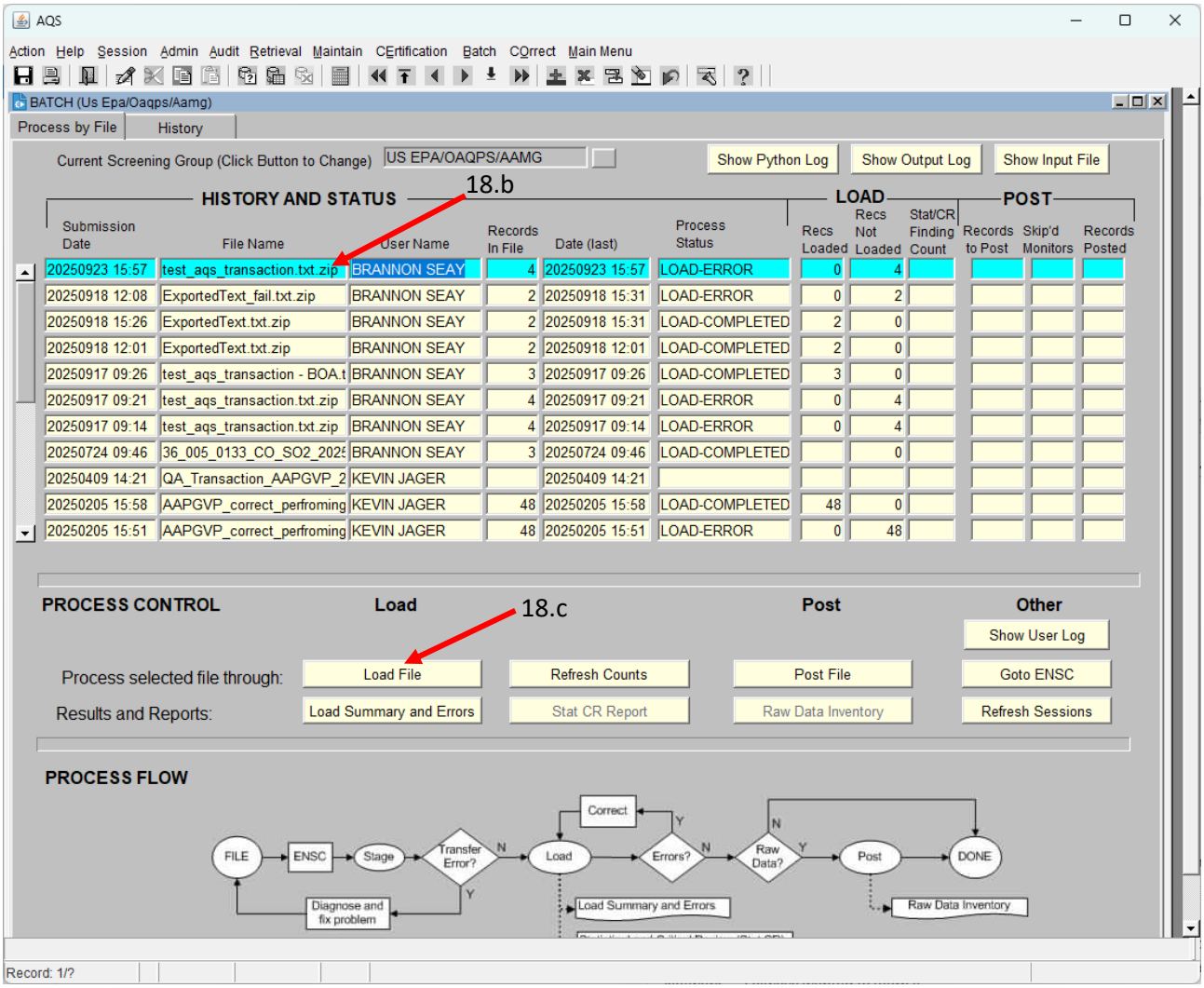


Figure 9-40. Loading the corrected data in AQS

19. Verify the corrected entry has loaded to AQS with no errors:
    a. Click the “Refresh Session” button until the new file load appears at the top of the batch screen table.
    b. Review the “Recs Not Loaded” column and ensure that it now reports “0”.

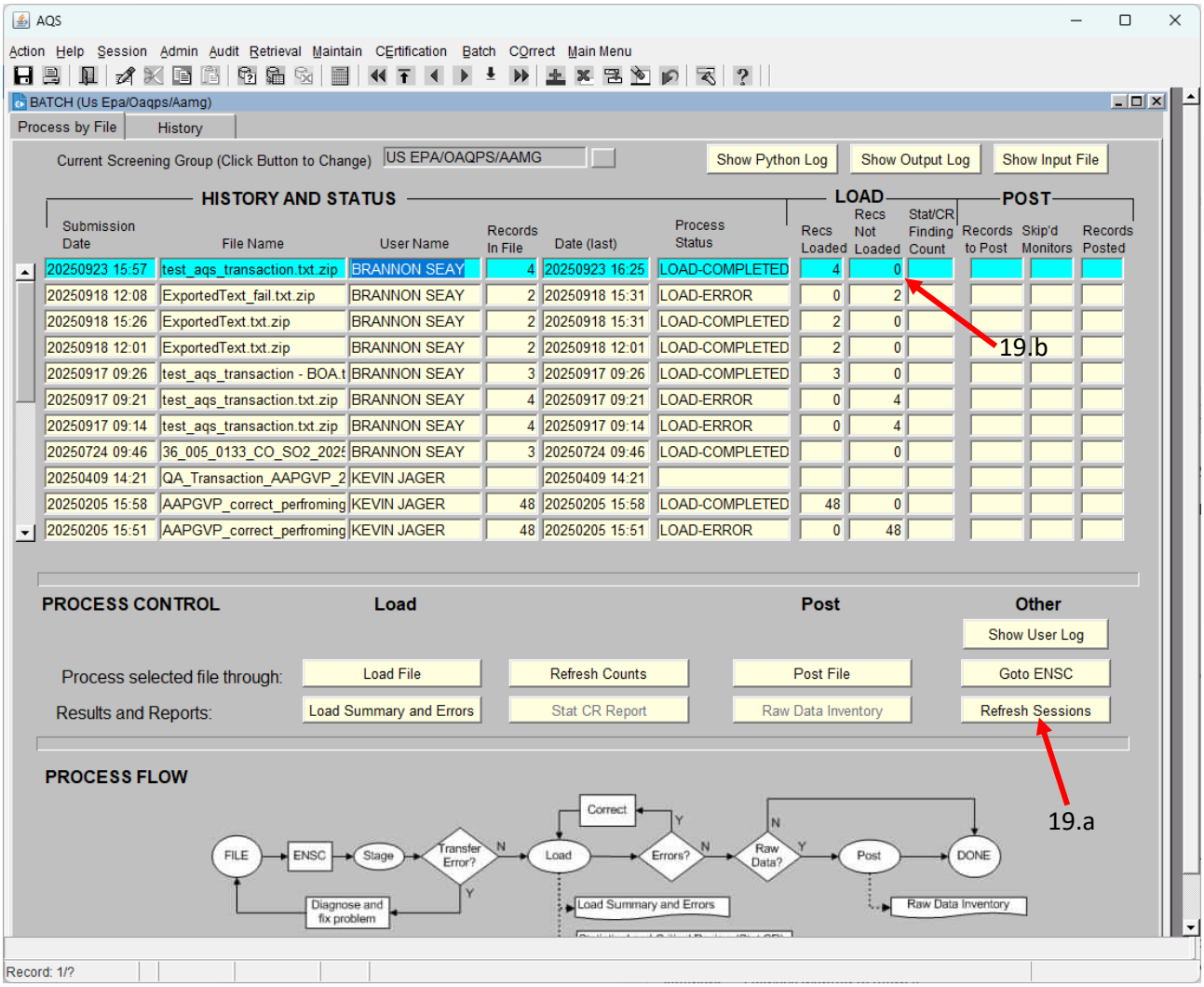


Figure 9-41. Verifying the corrected data has loaded to AQS

10. Data and Records Management

The FBA Workbook is an Excel workbook tool that facilitates performance of NPAP FBAs. EPA developed the FBA Workbook to streamline and automate the audit tasks, calculations, reports, and generation of AQS transaction strings necessary to upload audit results to the AQS database. All required audit related calculations are automatically performed within the FBA Workbook based on user inputs (e.g., multiblend tank concentrations, flow standard flow readings, station concentrations). The FBA Workbook verifies site and instrument (method codes, POCs, etc.) data to AQS and applies business rules to ensure transaction strings generated by the FBA Workbook will be accepted by AQS. The FBA Workbook is routinely updated with the latest AQS data to ensure that monitoring site data queried from AQS are current. EPA revises the FBA Workbook as needed when bugs are reported or when enhancements are completed. EPA encourages users to report FBA Workbook bugs, errors, and suggested enhancements to the OAQPS NPAP Lead. The FBA Workbook was built on Excel Version 2408 and will run on either the 32-bit version or the 64-bit version of Windows XP/7/8/10/11.

All records required to reconstruct an FBA must be maintained per NPAP QAPP Section A8. These include hard copy and electronic records for instrument calibrations and calibration verifications, standard materials certifications, and measurements recorded and instrument settings assigned for providing test gases to the monitoring station. The following includes data and records that must be retained and archived from every NPAP FBA:

- The completed FBA Workbook.
- All signed reports generated and provided to the agency staff.
- Data logger/DAS outputs from the audit (including the diluent and gas flow rate transfer standard time series).
- The AQS transaction string .txt files generated from the FBA Workbook.

11. Quality Assurance/Quality Control

The NPAP relies on a strictly enforced QC program that ensures calibration and maintenance of equipment (e.g., MFCs, ozone generators, ZAGs, flow rate transfer standards, etc.) are performed at designated intervals, standards are traceable to NIST, and that strict tolerance limits are followed. Table 11-1 summarizes the certification and calibration requirements of standard materials and instruments used in NPAP FBAs. The following subsections detail the calibration (standardization and verification of calibration) and performance specifications of instruments/devices.

Certification, calibration, calibration verification, and maintenance records are to be maintained for scientific equipment and standard materials employed in the NPAP as described in NPAP QAPP Section A8 and must be maintained per Section B10. Documentation of equipment/material certifications, such as a COA or similar, will be maintained and will detail the certification date, concentration(s), comparison results, certification expiration date, and any other relevant information. It is not acceptable to utilize standards or instruments that have expired certifications or do not have valid calibration or calibration verification within the required period. The following subsections detail procedures and their frequencies for standard, device, and equipment calibration, calibration verification, certification, characterization, maintenance, and contamination minimization.

Table 11-1. NPAP Standard Materials and Instrument Certification and Calibration Requirements

Device or Material	Certification or Verification Frequency*	Certification or Verification Standard	Specification
Multiblend certified gas cylinder (CO, NO, and SO_2)	Verification not to exceed 12 months.	Against first generation NIST standard gases by gas manufacturer or verification labs in Regions 4 or 7, or other certified gas analysis laboratory compliant with EPA AA-PGVP.	Within ±3% of the original certified concentration from manufacturer and within ±2% of the previous verification value.
ZAG output	Performance verified annually for each pollutant (CO, SO_2, NO_2).	Compared to zero air source scrubbed by external NO, Charcoal, and Pd scrubbers.	The audited station or in-house analyzer's response to zero air from the ZAG minus that from the ZAG routed/scrubbed through the external scrubbers must be: CO: ≤0.02 ppm SO_2: ≤0.001 ppm NO_2: ≤0.001 ppm.
Calibrator: gas dilution system, gas phase titrator, and ozone generator	Ozone generator verification conducted quarterly; if verification fails, a calibration (adjustment) must be performed and verified immediately after.	Against a Level 1 (standard reference photometer [SRP]) or Level 2 ozone standard.	Within ±5% of the selected standard at each concentration representing Levels 2 through 6.
	MFC verification conducted within the previous 12 months; if verification fails, a calibration (adjustment) must be performed and verified immediately after.	Against a certified reference flow transfer standard different than the standards employed during NPAP audits. Verification is performed at 3 flow rates spanning 10 to 90% of the flow rate range.	Verification must show indicated flow rate is within ±2% of the flow transfer standard reading for each tested flow rate.

Device or Material	Certification or Verification Frequency*	Certification or Verification Standard	Specification
	Ozonator flow verification (if applicable) conducted within the previous 12 months; if verification fails, consult the operating manual and/or vendor for corrective action guidance.	Against a certified reference flow transfer standard different than the standards employed during NPAP audits.	Verification must show the difference between the total flow rate while in GPT mode from the total flow not in GPT mode is within ±5% of the certified ozonator flow value.
Working flow rate transfer standards (*not applicable to reference standards*)	The flow rate transfer standards in-line with the gas dilution calibrator are verified within the previous three (3) months.	Against certified reference flow rate transfer standards. Verification is performed at 3 flow rates spanning 10 to 90% of the flow rate range.	Verification must show indicated flow rate is within ±2% of the reference flow transfer standard reading for each tested flow rate.
Reference flow rate transfer standards (*not applicable to working standards*)	Reverification conducted annually by a qualified NIST-traceable metrology laboratory.	Calibration verified or established against a NIST-traceably certified flow standard. Verification is performed at 3 flow rates spanning 10 to 90% of the flow rate range.	Within ±1% of the NIST-traceably certified standard across the flow range.
Environmental conditions temperature sensor	Temperature sensor calibration verified within the previous 12 months.	Readings verified against a NIST-traceably certified temperature standard at minimally one temperature between 20 to 30 °C.	Within ± 2 °C of the standard reading(s). If outside this criterion, adjust the sensor's response to match the standard's

* FSs are encouraged to address material certifications and equipment calibrations during the off-season (i.e., December through January) for those with frequency requirements of ≥ 6 months.

11.1. Multiblend Gas Cylinder

11.1.1. Cylinder Verification

The concentrations of CO, NO, and SO_2 in the multiblend tank must have been reverified within the previous 12 months against first generation NIST standard gases. This can be performed by an AA-PGVP compliant gas vendor (e.g., the gas manufacturer) or by the verification labs in Regions 4 or 7. For reverification, the measured concentration of each gas must be within ±3% of the original certified

concentration from the manufacturer and within ±2% of the most recent reverification value. Any cylinder which fails these criteria must be recertified before being employed in the NPAP.

FSs are recommended to not use high pressure cylinders when pressures fall below 400 psi as low cylinder pressures cause erratic behavior in the gas calibrator. FS should not use cylinders when pressures fall below 200 psi as this will not permit analysis (for reverification) of the cylinder upon retirement.

11.1.2. Cylinder Regulator Attachment and Purging

In addition to following all safety precautions when working with compressed gas cylinders, regulator installation should be performed carefully to prevent ambient air in detached regulators from backflowing into gas cylinders, contaminating the cylinder. Entrainment of ambient air into a standard cylinder will change the certified concentrations of the standard gases, resulting in errors in conducting audits.

If it is suspected that the multiblend cylinder has become contaminated, the FS should procure a replacement cylinder as soon as possible and have the suspect cylinder recertified (not reverified).

To attach and purge a regulator, perform the following steps and refer to Figure 9-14.

1. Due to the potentially dangerous concentrations of criteria gas pollutants in the cylinder, always purge regulators in a well-ventilated area with a vent line (>10 ft in length) so that the vented gas is a safe distance away from people and animals.
2. Attach the clamshell valve cover to the cylinder.
3. Ensure the regulator outlet valve and tank valve are closed.
4. Attach the regulator to the cylinder and hand tighten the regulator connection, avoiding cross-threading.
5. Securely tighten the regulator connection with a wrench.
6. Turn the pressure adjusting knob to minimize output pressure until the knob turns freely (counterclockwise in Figure 9-14).
7. Fully open the regulator outlet valve.
8. Slowly and fully open the tank valve (gas will emit from the regulator) and quickly close the tank valve.
9. Close the regulator outlet valve.
10. Wait approximately one (1) minute (to allow cylinder gas to permeate the voids and seals within the regulator to passivate the interior wetted surfaces of the regulator).
11. Repeat steps 7 through 9 two more times.
12. Connect gas routing plumbing to the regulator outlet and adjust the output pressure accordingly (follow pressure guidance for the gas calibrator).

The following practices will minimize the entrainment of ambient air into the regulator and cylinder:

1. When both the regulator outlet valve and the tank valve are open, always close the tank valve first to ensure contaminated air within the regulator cannot backflow into the tank.
2. When both the outlet valve and the tank valve are closed, open the regulator outlet valve first to ensure contaminated gas within the regulator is purged and cannot backflow into the tank.

11.2. Zero Air Generator (ZAG)

11.2.1. ZAG Maintenance

Table 11-2 describes maintenance frequency requirements for various ZAG components. The scrubber consumables within the ZAG should be replaced annually and the unit serviced as recommended by the manufacturer. Consumables to replace during the annual maintenance minimally include the activated carbon (charcoal), Purafil®, and particulate filter, and may include the molecular sieve if there was evidence of degraded performance. If produced zero air indicates contamination or dewpoint failures in between regular maintenance, it may be necessary to replace the CO scrubber and/or dryer. Following maintenance, the ZAG should be powered on, a leak check performed, and the ZAG run (e.g., in maintenance mode) for several days to condition replaced materials.

Table 11-2. Zero Air Generator Maintenance Frequency

Component	Replacement/Maintenance Frequency
Activated Carbon	Annual
Purafil®	Annual
Particulate Filter	Annual
Molecular Sieve	As Needed
CO Scrubber	As Needed
Dryer	As Needed

11.2.2. ZAG Performance Verification

As detailed in step 16 of Section 9.5.6 and Table 11-1, the ZAG performance is verified annually by comparing either the audited station or in-house (if available and maintained) analyzers' CO, NO_2, and SO_2 response to (1) zero air from the ZAG and subsequently to (2) zero air from the ZAG routed through an NO, Charcoal, and Pd scrubbers. To verify proper ZAG performance, the untreated ZAG output must show a CO concentration no more than 0.020 ppm higher and NO_2/SO_2 concentrations no more than 0.001 ppm higher than the scrubbed ZAG. Note that if properly functioning, the scrubbed ZAG concentration is not expected to be appreciably lower.

As noted above, the ZAG verification may be performed utilizing either (1) station analyzers at a monitoring site during an NPAP audit or (2) analyzers operated and maintained within the Region.

1. Using station analyzers:
    a. The FBA Workbook includes an optional audit point to perform the ZAG verification if conducted during an audit (detailed in step 16 of Section 9.5.6). The FBA Workbook in this case can serve as the documentation for completing the ZAG verification.
    b. Ideally, the ZAG verification is performed at a monitoring site in which all three pollutants (CO, NO_2, and SO_2) are being audited, as this minimizes the number of times the verification must be performed each year. This is not required, however, and individual pollutants can be verified during separate audits if necessary.
2. Using in-house analyzers:
    a. The ZAG Verification Workbook (available on the NPAP Teams Channel) can be used to perform and document the ZAG verification.

b. The analyzers used to perform the verification must be designated as FRM/FEM and meet QA requirements as described in 40 CFR Part 50, 53 and 58. Further, FSs must maintain adequate knowledge and training in operating the equipment.

11.3. Gas Dilution Calibrator

11.3.1. Ozone Generator Verification and Calibration

The calibration of the gas dilution calibrator ozone generator is to be verified quarterly (within the previous three months) against a Level 2 ozone standard (e.g., the NPAP ozone analyzer) or a Level 1 standard (i.e., an SRP) at a minimum of five concentration levels with each level representing audit Levels 2 through 6. The ozone measured with the Level 1 or 2 standard must be within ±5% of the intended concentration or the ozone generator must be recalibrated (adjusted). Refer to the gas calibrator manual for the ozone generator calibration procedure. After calibrating, a calibration verification must immediately be performed.

11.3.2. Mass Flow Controller Verification and Calibration

The gas dilution calibrator MFCs must be verified annually (within the previous 12 months). If the verification fails, a calibration (adjustment) must be performed followed immediately by a calibration verification. An independent flow rate transfer standard different than that employed during NPAP FBAs, e.g., the NPAP reference transfer standards, must be used to perform MFC verifications and calibrations.

To perform a verification, each MFC is tested at three (3) flow rates spanning 10 to 90% of the flow rate range (e.g., for a 50 SCCM MFC, test at 5, 15, and 45 SCCM) and the flow measured with the independent flow transfer standard must be within ±2% of the flow setting or else calibration is necessary. Refer to the gas calibrator manual for the MFC calibration procedure. After calibrating, a calibration verification must immediately be performed.

11.4. Flow Rate Transfer Standards

FSs must maintain two sets of flow rate transfer standards:

1. The working standards, i.e., the diluent and gas standards used in-line with the gas calibrator during NPAP audits.
2. An independent set of reference standards that are used to verify the working standards.

11.4.1. Working Standard Quarterly Verifications

The working flow rate transfer standards (both diluent and gas) must be verified quarterly (within the previous three [3] months) against a set of independent certified reference standards.

To perform a verification, each working flow rate transfer standard is tested at three (3) flow rates spanning 10 to 90% of the flow rate range (e.g., for a 50 SCCM MFC, test at 5, 15, and 45 SCCM) and the flow measured with the independent reference flow transfer standard must be within ±2% of the working standard. In the event of a verification failure, the standard must be serviced/re-calibrated and a subsequent successful reverification performed prior to use during an NPAP FBA. Refer to the vendor manual for servicing/calibration procedures. Standards likely cannot be calibrated by FSs and will require returning to the vendor for maintenance.

11.4.2. Reference Standard Annual Metrology Laboratory Reverifications

The reference flow rate transfer standards must be reverified annually (within the previous 12 months) at a qualified NIST-traceable metrology laboratory.

To perform a reverification, each flow rate transfer standard is tested at three (3) flow rates spanning 10 to 90% of the flow rate range (e.g., for a 50 SCCM MFC, test at 5, 15, and 45 SCCM) and the flow measured with the NIST-traceably certified flow standard must be within ±1% of the reference transfer standard.

11.5. Environmental Conditions Temperature Sensor Verification

The temperature sensor used to record environmental conditions within the NPAP environment (e.g., inside the NPAP van) must be verified annually (within the previous 12 months) against an external temperature standard of known, NIST-traceable accuracy.

The verification must be conducted minimally at one temperature point between 20 to 30°C. To perform the verification, place the temperature standard within approximately one (1) centimeter of the temperature sensor and allow the standard reading to stabilize. Compare and record the readings from the two devices. If the two temperatures agree to within ±2°C, then the temperature sensor response is acceptable. If the two temperatures deviate by more than ±2°C, the sensor's response must either be (1) adjusted to match the standard's or (2) replaced.

11.6. External Scrubber System

The external scrubber system includes individual NO, Charcoal, and Pd scrubbers and is used to verify the performance of the ZAG. If needed, scrubbers can be requested from the OAQPS NPAP Lead. The assembled scrubber system is plumbed into the NPAP audit system according to the recommended plumbing schematic in Figure 7-1. Details on assembling the scrubber system are included in Appendix A. Maintenance requirements for the scrubber media are as follows:

1. **NO Scrubber**: The Purafil® media should be replaced every 5 years or when the color changes from purple to brown, whichever is sooner. Note, the color change in the Purafil® is generally subtle.
2. **Charcoal Scrubber**: The activated charcoal media should be replaced every 5 years.
3. **Pd Scrubber**: Once assembled, the Pd scrubber does not contain consumable material and should last the lifetime of the audit equipment assembly.

11.7. Teflon® Gas Delivery Hose

New PTFE Teflon® gas delivery hoses must be cleaned to remove manufacturing residues and conditioned, i.e., "burned-in," prior to use. Even with proper cleaning and preparation, the delivery hose will scrub some amount of ozone from the delivered gas. The cleaning and conditioning are intended to minimize this scrubbing.

For new hoses, the hose is flushed with tap and deionized water, dried by flushing with dry zero air, and subsequently conditioned with ozone to eliminate potential reactive sites within the hose flow path.

Clean and condition a new PTFE delivery hose as follows:

1. Flush the hose with tap water for ≥ 1 minute.
2. Rinse the hose with deionized water for ≥ 15 seconds.
3. Dry the hose with zero air for ≥ 12 hours.
4. Condition the hose with ~500 ppb ozone @ 3 LPM for ≥ 24 hours.

5. Condition the hose with ~100 ppb ozone @ 3 LPM for an additional ≥ 48 hours.
6. Condition the hose with ~200 ppb SO_2 @ 3 LPM for ≥ 1 hour.
7. Cap the conditioned delivery hose.

Note, since every Region performs O_3 audits (not applicable for FBAs), the delivery hose must undergo an ozone line loss test prior to use. Refer to the NPAP MVA SOP Appendix B for instructions on the performance and frequency requirements of this test.

11.8. Data Acquisition System

Envidas Ultimate software serves as the DAS for the NPAP. This DAS is computer-based and does not require a separate discrete data logger. Users can display readouts and annotate readings within the software via the computer interface. The Envidas Ultimate software can be acquired by request from the OAQPS NPAP Lead and should be installed following the vendor's specification.

11.9. FBA Workbook and Tablet or Laptop Personal Computer

A Windows-compatible (refer to Table 7-1) tablet or laptop PC with the Microsoft Excel spreadsheet editor installed is required for using the FBA Workbook. For proper operation, prior to audit trips, FSs and/or Regional NPAP Leads should check for and install available updates to the operating system, antivirus software, and the latest FBA Workbook version on the tablet and laptop personal computers. The current version of the FBA Workbook is maintained on the NPAP Teams Channel and is routinely updated with the latest AQS data. Updates may also be installed during audit trips such as when connected to the internet at hotels.

11.10. Audit Transport Vehicle and Supporting Equipment

FSs should maintain logbooks for the audit equipment transport vehicle and support equipment that requires periodic maintenance. This recordkeeping is especially important when multiple FSs share equipment to ensure that maintenance schedules are followed. Equipment logs should be kept with the equipment covered.

Maintenance activities for the audit transport vehicle and supporting equipment described in the following subsections are typical and should not be considered an exhaustive list. Each Region's complement of transport equipment will be unique to the Region, therefore FSs and/or Regional NPAP Leads are encouraged to specify maintenance and associated frequencies as the unique procedures and maintenance frequencies are outside the scope of this SOP.

11.10.1. General Vehicle Maintenance

Due to the potential for liability, FSs should not perform maintenance on the NPAP vehicle, and it should be performed only by certified mechanics. The odometer reading and date should be recorded for any routine periodic maintenance performed, including, but not limited to:

- engine oil and filter change
- coolant flush and replacement
- air filter change
- tune up
- fuel filter replacement
- tire rotation or replacement
- suspension adjustment and/or alignment

11.10.2. Electrical Generator

Electrical generators should be properly maintained to ensure trouble-free operation. FSs should check the oil level before each use and add oil as needed. Long periods of inactivity can degrade generator performance. Therefore, generators should be run monthly for approximately 30 minutes to keep the components well-lubricated and prevent oxidation of electrical contacts. Addition of fuel stabilizer when refueling will reduce the likelihood of fuel system varnish build-up. Record maintenance (routine or non-routine) in the logbook, including, but not limited to:

- oil and oil filter change
- coolant flush and replacement
- air filter change
- tune up
- general inspection by a certified generator technician
- fuel filter replacement

11.10.3. HVAC System

For mobile laboratory-type systems (recreational vehicle, trailers, etc.) the equipment installed requires an HVAC system to maintain the required operable temperature range for NPAP measurement instruments of 20 to 30 °C (68 to 86 °F). Additionally, fluctuations within this range may result in measurement response instability and drift, therefore fluctuations should be minimized to the extent possible. The HVAC system should be serviced if it cannot maintain the temperature within this range.

11.10.4. Trailer Maintenance

FSs operating trailer-based configurations should complete the form in Table 11-3 prior to each audit trip and indicate whether each item is satisfactory or unsatisfactory and add notes where needed. Unsatisfactory items must be remedied before the trailer can be towed. The odometer reading and date the maintenance is performed should be recorded, including, but not limited to:

- Tire rotation for the trailer
- Turn signal and brake light check

Table 11-3. Trailer-Based Safety Checklist

Region: **Reviewer:**_____ **Date:**_____

		SAT.	UNSAT.	NOTES
Tow Vehicle	1. The tow vehicle has enough power and braking capacity to safely tow the trailer load.			
	2. The tow vehicle has received regular preventative maintenance work. Record odometer reading in NOTES column.			
	3. The tow vehicle has adequate fuel, battery power, oil, and engine coolant.			
	4. The tow vehicle tires are properly inflated and balanced; tires do not show excessive wear or damage.			
	5. The wheel fasteners (lug nuts) are present, tight, and free of rust.			
	6. Wheel rims are free from damage.			
	7. Tow vehicle is level when attached to the loaded trailer.			
	8. All lights (dash lights, head lights, tail lights, clearance lights, brake lights, directional signals, hazard light, high beams, reflectors) are in proper working order.			
	9. Weight is properly distributed between the trailer and the tow vehicle.			
	10. All brakes are in proper working order.			
	11. Side view mirrors provide an unobstructed rear view on both sides of the vehicle.			
Hitching Apparatus	1. The receiver is properly and securely mounted to the tow vehicle.			
	2. The receiver, draw bar, hitch ball, coupler, sway control device, spring bars, safety chains, and power connection wiring are all functional and compatible with the tow vehicle and trailer.			
	3. The power and brake control connections between the trailer and tow vehicle are compatible, provide enough slack for turning, are in good working order and are of proper length for brake to be activated if the trailer separates from the hitch.			
	4. The landing gear (trailer jack) is functional.			
	5. The hitch ball and coupler are the same size. When attached, the ball is firmly seated in the coupler, and the latching mechanism is locked.			

12. References

Note, all links provided in the reference list below were accessed and current as of October 2025.

1. 40 CFR Part 58 Appendix A, available at: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-58#Appendix-A-to-Part-58
2. 40 Code of Federal Regulations Part 50, Appendices A, C, D, and F, available at: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-50
3. Air Quality System (AQS) User Guide. U.S. Environmental Protection Agency. Available at: https://www.epa.gov/aqs/aqs-user-guide
4. Models T700 and T700U Dynamic Dilution Calibrators, User Manual, Teledyne API, 083730700D DCN8606, 08 November 2022. Available at: https://www.teledyne-api.com/en-us/Products_/Documents/Manual/083730700D%20-%20MANUAL,%20USER,%20NVS,%20T700,%20T700U.pdf
5. Models T701, T701H, 701, and 701H Zero Air Generators, Operation Manual, Teledyne API, 07825F DCN8419, 11 June 2021. Available at: https://www.teledyne-api.com/en-us/Products_/Documents/Manual/078250000G%20-%20MANUAL,%20T701-T701H_701-701H.pdf
6. Quality Assurance Project Plan for the Federal National Performance Audit Program (NPAP) for Criteria Pollutant Gases. EPA-454-B-19-012. U.S. Environmental Protection Agency. June 2021. Available at: https://www.epa.gov/system/files/documents/2021-09/npap-qapp_revision-6_epa-454_b-19-012_september-14-final_0.pdf
7. Quality Assurance Handbook for Air Pollution Measurement Systems Volume II, U.S Environmental Protection Agency. January 2017. Available at: https://www.epa.gov/sites/default/files/2020-10/documents/final_handbook_document_1_17.pdf
8. Series 6100 Multi-Gas Calibrator, User's Guide and Technical Manual, Revision 14, October 2019. Available at: https://www.environics.com/wp-content/uploads/2021/03/Series-6100-User-Manual-Rev-14-PC401-only-1.pdf
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Appendix A: Details on the External NO, Charcoal, and Palladium (Pd) Scrubbers

Three external scrubbers (NO, Charcoal, and Pd) are employed to verify the ZAG is providing zero air that has been sufficiently scrubbed of NO, NO_2, SO_2, and CO. As depicted in Figure 7-1, the scrubbers must be ordered from upstream to downstream as follows: NO à Charcoal à Pd. Details on each of the individual scrubbers are provided in the following subsections.

A.1 NO Scrubber

The NO scrubber uses Purafil® pellets to oxidize NO to NO_2. It is important that the NO scrubber is upstream of the charcoal scrubber to ensure all NO is converted prior to the charcoal scrubber removing NO_2.

Table A-1. External NO Scrubber Components[a]

Part Description	Manufacturer	Part #
Refillable scrubber assembly	Thermo	6996
Purafil® (or equivalent) 1/8-inch pellets	Thermo	7075

[a] Equivalent components can be sourced, e.g., the Purafil® media can be sourced directly from Purafil Filtration Group.

A.2 Charcoal Scrubber

The Charcoal scrubber uses activated charcoal pellets to remove NO_2 and SO_2. It is important that the Charcoal scrubber is:

- Downstream of the NO scrubber to ensure all NO is converted to NO_2 prior to entry in the Charcoal scrubber and the latter may not efficiently scrub out NO.
- Upstream of the Pd scrubber to ensure all SO_2 is scrubbed prior to entry in the Pd scrubber as SO_2 can damage the latter.

Table A-2. External Charcoal Scrubber Components[a]

Part Description	Manufacturer	Part #
Refillable scrubber assembly	Thermo	4291
Activated charcoal pellets	Thermo	4157

[a] Equivalent components can be sourced.

A.3 Pd Scrubber

The external Pd scrubber effectively scrubs several ppm of CO at a nominal 16 LPM flow rate without the need for a catalyst heater. It is important that the Pd scrubber is downstream of the charcoal scrubber to ensure all SO_2 is scrubbed prior to entry into the Pd scrubber as SO_2 can damage the Pd scrubber.

Table A-3. External Pd Scrubber Components[a]

Part Description	Manufacturer	Part #
Refillable Hydrocarbon Trap	Restek	22013
Glass Wool	Pyrex	3950
Palladium Coated Alumina Pellets	Acros Organics	195082500

[a] Equivalent components can be sourced.

Procedure:

1. Open the hydrocarbon trap and empty the contents. It may take a vice and strap wrench to open the body. Instruction for disassembly of the hydrocarbon trap is available here: http://www.restek.com/pdfs/204-08-017.pdf
2. Remove frit from both ends with a small screwdriver (Figure A-1).

Figure A-1. Removing Frits from End Caps

3. Use compressed air to remove any large residual particles of carbon media from the hydrocarbon trap body and caps (wear safety glasses).
4. Rinse with hydrocarbon trap body and caps with deionized water and air dry.
5. Install one end cap and pack the trap body lightly with ~1 inch thick of glass wool against the installed cap (Figure A-2).

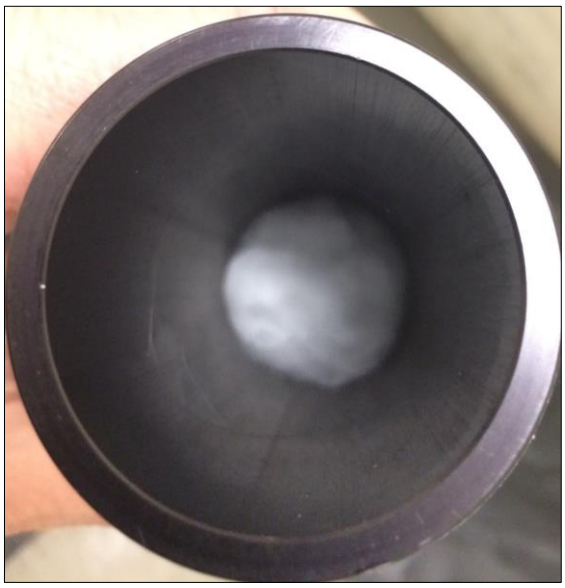

Figure A-2. Glass Wool Bottom Plug

6. Fill the trap body with approximately 90 grams (g) of Pd coated alumina pellets (Figure A-3).

Figure A-3. Addition of Palladium Coated Pellets

7. Lightly pack an approximately 1-inch thick plug of glass wool on top of the Pd coated pellets (Figure A-4). The glass wool plug should be sufficient to keep the pellets in place without adding compression which can restrict flow.

Figure A-4. Glass Wool Top Plug

8. Install the other cap onto the trap body and firmly hand tighten the two caps.
9. The external Pd scrubber is ready to be securely installed into the audit equipment apparatus to be used to check for CO and NOx contamination in the ZAG. See Figure 7-1 for the recommended plumbing schematic.