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NORTH CAROLINA
Environmental Quality

Ozone Monitoring Standard Operating Procedures
Thermo Scientific Model 49i Ozone Monitoring System
Section 2.7.2 Operators Responsibilities
Revision 8.0
February 21, 2020

NORTH CAROLINA
Department of Environmental Quality

APPROVAL SIGN OFF-SHEET

I certify that I have read and approve of the contents of the Model 49*i* UV Photometric Ozone (O_3) Analyzer Monitoring System-Operator Responsibilities Standard Operating Procedure Section 2.7.2 with an effective date of March 1, 2020.

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This document, and any revision hereto, is intended as a reference guide to assist operators in the setup, calibration, maintenance, operation, and data collection as related to the NC DAQ Ozone Monitoring Program. It is intended as a supplement for training in addition to other NC DAQ Reference Manuals, QAPP's, and EPA Guidance. It is not a substitute for the extensive training and experience required for the efficient operation of ambient air monitoring equipment needed for scientifically valid data.

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2.0 SCOPE AND PURPOSE

The Division of Air Quality of the Department of Environmental Quality (DAQ) determines the ground level concentration of ambient air ozone throughout North Carolina as required by the 1970 *Clean Air Act* and the subsequent Amendments (1977 & 1990) thereto. In response to increasing levels of air pollution the Clean Air Act was written with the purpose to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population". In short, the Clean Air Act established ambient air quality as a national resource that must be protected. The EPA is designated with the responsibility to administer and assist in the nationwide program to protect and improve air quality. Each state is assigned the direct responsibility for assuring air quality within its borders.

Monitoring and reporting of ozone concentrations across North Carolina is required by the EPA to occur from March 1st through October 31st each year. This is a major undertaking and requires a coordinated effort by both Regional and Raleigh Central Office (RCO) staffs of the Division of Air Quality to satisfactorily meet this requirement. North Carolina operates one of the most extensive monitoring networks and effectively measures ground level ambient ozone concentrations in urban, rural, and regional transport areas of the state.

In order to collect data of the highest integrity and accuracy, the monitors and calibrators must be tested, calibrated, and operated in a consistent and rigorous manner. The ultimate goal is to present verifiable and defensible data and procedures consistent with Methods developed by US EPA and delineated in Federal Register documents contained within 40-CFR 50, 53, and 58 and well as the EPA QA Handbooks Volumes I and II.

All original records (electronic and hard copy logs, etc.) must be legibly dated, signed/or initialed as appropriate, and complete and retained by the operator(s) to certify that the said activities have indeed been performed and documented in a consistent and regimented manner and in accordance with the NC DAQ QAPP's and the NC DAQ SOP's. All records will be reviewed and verified by the Regional Ambient Monitoring Coordinators and subsequently audited and verified by the Central Office chemist at the NC Division of Air Quality RCO.

3.0 EQUIPMENT CHECKS

3.1 Ozone Monitoring Instrumentation, Equipment, and Accessories

This section presents the operating procedures to be followed for the ozone monitoring systems installed statewide. These operating procedures are designed to produce the highest quality ozone data possible. It is critical that these procedures be followed. If questions arise technical assistance is available from the Projects and Procedures Branch (PPB) and the Electronics and Calibration Branch (ECB) of the Ambient Monitoring Section of the NC Division of Air Quality.

Ozone monitoring sites are equipped with ozone monitor calibrators, ozone monitors, zero air supplies, data collection software. Also included are Windows compatible computers, modems, air conditioners and heaters. The critical and essential procedures for the operation and checks to establish and verify performance of the ozone monitoring system are contained in this section. The significant instrumentation and equipment at each NCDAQ ozone monitoring site includes:

1. Thermo Environmental Model 49i-PS Transfer Standard (calibrator)
2. Thermo Environmental Model 49i Ozone Analyzer.
3. Teflon Sampling Line (5/32" ID)
4. Teledyne API Zero Air Supply
5. Computer/Modem System/Wireless/Ethernet connectivity
6. Temperature Controlled Monitoring Shelter
7. Comet temperature sensor, HOBO back up temperature sensor (shelter temperature) and NIST certified thermometer

Note: minor components are not specified but included by reference

3.2 Ozone Monitoring Checks and Procedures

Following the installation of the monitoring system, the Regional Monitoring staff has responsibility for the operation of the monitoring system at each site throughout the ozone season. The Regional Staff Operational Responsibilities include the following:

1. **Ozone Monitoring Logbook**. The site-specific Ozone Monitoring Logbook is the primary document and record for the evaluation of the performance of the ozone monitoring system and the quality of all ozone data produced at each site. This essential record must be completed by the site operator during each site visit to thoroughly document the results and findings of all site activities. The ozone monitoring logbook contains sections with Instructions, a Flow Chart of Activities, Site Documentation, Monitor Calibration, Filter Conditioning, On-Site Manual Performance Check, and Office Actuated Checks. The Ozone Logbook worksheet sections are included on pages 66-84 of this document.

2. **Ozone Monitor Performance Evaluation and Flow Chart**. This flow chart details monitor activities in a decision tree model. See page 73.

3. **Site Documentation and Inspection.** The ozone monitoring site must be inspected and the instrumentation and equipment must be documented during each site visit (see page 74-75 Documentation). The condition of the overall monitoring system, the security of the monitoring site, and activities adjacent to the monitoring site that may impact the quality of the ozone data produced must be documented. The site documentation worksheet also contains the recording of lamp frequencies and the sample cell flow rates. The recorded sample cell flow rates are then used to determine the sample line sample residence time which must be less than 20 seconds. Site inspections are a critical step to ensure representative and accurate ozone data is reported. If the site operator determines additional site visits are necessary to ensure accurate data and/or if the site operator is tracking a site performance issue or condition that may impact data quality, then additional site inspection visits are warranted. This is to a degree site dependent.

4. **Ozone Monitor Calibration with Multi-Point Verification**. The initial Calibration with multi-point verification performed prior to March 1st establishes the starting point for ozone data collected each year at each site. Throughout the ozone monitoring season performance checks are conducted on the ozone monitoring system. If the system fails these performance checks or if maintenance and repair or replacement of instrumentation is required then the operator must conduct an On-site manual performance check, which must include a **zero (0 ppb)**, **precision (65 ppb)**, and **span (225 ppb)** test points to demonstrate the system is operating within the required performance standards. If critical components (**Calibrator, Monitor, Zero Air Supply**) are changed at the monitoring site or major system maintenance (cell cleaning, solenoid replacement, lamp replacement, pump replacement, scrubber replacement, and sample lines in the calibration pathway or internal to the instruments are changed) then a calibration with multi-point verification is **required**. If electrical power is lost for less than 72 hours no action is required unless the next Precision/Zero/Span (PZS) fails. If the electrical power is lost for more than 72 hours, then an On-Site manual performance check is required to re-establish the link to our state transfer standard. If that check fails to meet acceptance criteria, then a calibration with multipoint verification is **required** to re-establish the direct data link to the North Carolina Standard Ozone Photometer. The Ozone Monitor Calibration Worksheet is included on pages 76-77 and a summary of the procedure is on pages 59-60.

5. **Daily Auto-Precision/Zero/Span (PZS) Check and Precision Point Analysis.** This unattended daily performance evaluation (auto PZS) determines the ongoing accuracy and stability of site-specific ozone monitoring system. The review of this ongoing performance evaluation of the ozone monitoring system must occur as early as possible each day. This daily quality of data reported check includes the required analysis of the Precision Point (65 ppb) as well as the Zero/Span check(s) which are reported to the EPA on an on-going basis. If the ozone monitoring system fails to meet the Critical Data Acceptance Criteria of the Daily Auto-PZS Check, at a minimum an **Office Actuated Manual Performance check** would be merited. An **On-Site Manual Performance Check** and **site inspection** may be required depending on the circumstances. Sometimes anomalies occur such as 'Data Drop', small power failures, etc. and it is up to the Site Technician and Regional Office to determine if a site visit is merited. If the Auto PZS fails twice consecutively (over a 48-hour period) a site visit is highly recommended.

If the operator/region opts to not visit the site, then a significant amount of data could potentially have to be invalidated and negatively impacting the completeness requirements.

The first Daily Auto-PZS Check immediately following the end of the ozone monitoring season also serves as the closing one-point-quality control check for all ozone data reported at each ozone site. These daily evaluation reports are reviewed by the site operator, Regional Ambient Monitoring Coordinator and the Projects and Procedures Chemist.

6. **Daily Site Temperature Review.** The ozone monitoring sites must be maintained between 5-40° C for the ozone data collected to meet federal acceptability standards. All data reported including all calibrations and QA checks must be invalidated if reported outside of this temperature range. The values are reported as is and not rounded or truncated. A high value of **40.1** would exceed the acceptable standard (40.0) and would have to be marked as invalid (coded **AE**) due to shelter temp.

7. **Daily Ozone Site Data Review.** This review is to determine if any unusual hourly average ozone concentration values (high or low) or patterns have been reported. Site Operators/technicians are required to review the overnight data polled by and contained in the Envista system. An abbreviated version of the Daily Polling report is presented on pages 28 and 30 of this SOP.

8. **Changing and Conditioning of Particulate Filters.** The particulate filter is a critical part of the ambient air sampling system for it protects the ozone monitor from contamination. A new particulate filter must be installed and conditioned prior to all ozone monitor Calibrations and is **required** every 30 days throughout the ozone season. It is now **mandatory** that a pre-leak check be performed before changing the filter and then a post-leak check following the filter conditioning and change out. The conditioning of the new particulate filter is performance based. When the results of the conditioning cycle meet the Acceptance Criteria the filter is conditioned. The installation and conditioning of the particulate filter requires the ozone monitoring system to be taken out of the ambient air sampling and analysis mode.

During the ozone monitoring season if the Ozone **AQI** forecast is ≥ **65** and Code Yellow and the ozone monitoring system has met all of the Data Acceptance Criteria of the Daily Auto-PZS Check, it is recommended that the changing and conditioning of the particulate filter be postponed until the AQI forecast is < **65**. If this is not possible due to regional staff schedules it is recommended that the particulate filter change and conditioning be performed following the **12 Minute Rule** described below. If the changing and conditioning of the particulate filter is postponed due to the elevated ozone forecast (AQI ≥ **65**) the operator must continue to monitor and evaluate the performance of the Daily Auto-PZS Check and must change and condition the particulate filter when the ozone AQI Forecast is < **65**. If the ozone monitoring system fails, the Daily Auto-PZS Check an On-Site Calibration Performance Check **must** be performed prior to performing the Particulate filter Change and Conditioning. See pages 30-34 for the detailed procedures for changing and conditioning the particulate filter. Pages 55-57 summarize the procedures for changing and conditioning the filter. The Particulate Filter Change and Conditioning elog worksheet is on pages 78-79.

9. **On-Site Calibration/Verification Check.** The On-Site Manual Performance Check is strongly recommended to be performed following **ALL FAILURES** of the ozone monitoring system to meet the Daily Auto-PZS Check and Precision Point Analysis data acceptance criteria regardless of the Ozone AQI forecast. This check is performed when eminent failure of the monitoring system is observed or suspected. The On-Site Manual Performance Check includes a complete site inspection and evaluation of the Ozone monitoring system. An On-Site Manual Performance Check requires the ozone monitoring system to be taken offline and out of the ambient air sampling and analysis mode. It is highly recommended that the On-Site Manual Performance Check be performed as early in the day as possible throughout the ozone season. The operator is encouraged to use the **12- Minute Rule** to minimize the loss of hourly data. However, if a problem in the operation of the ozone monitoring system has been identified, the goal is to report the highest quality ozone data possible. See pages 66 and 70 for more information and 80-81 for the elog workbook.

10. **Office Actuated Manual Performance Check** An office actuated manual performance check may be performed to evaluate instrument performance problems. It is noteworthy that problems may be due to a power failure or data drop when all additional data indicates the site is operating properly and meeting data acceptance criteria. See pages 66 and 71 for more information and page 80 for the elog workbook.

11. **The Envista System** is the source of ozone data reported to the EPA and used for all comparisons with the ambient air quality standards. The **Data Loggers** have been phased out. The site computer real time data is utilized as the primary, and if computer fails, then storage in the O3 analyzer (49i) will be used as secondary back-up source of monitoring data.

12. **Data report Validation.** The Regional site operator and Ambient Monitoring Coordinator are required to validate the monthly concentration data and precision point analysis (Precision/Zero/Span (PZS) reports prior to sending to RCO Chemists for final validation.

Note: 12-Minute Rule. Site Activities such as an On-Site Manual Performance Check and Particulate Filter Change and Conditioning requires the ozone monitor to be taken out of the sampling mode. This should be performed whenever possible between 12 minutes before the hour and 12 minutes after the hour. The loss of 12 minutes of data in either hour will not result in the invalidation of either hour of ozone data. The EPA hourly data reporting requirement is that 75% of an hour or 45 minutes of the 60 minutes in an hour constitutes the minimum number of minutes that can be used to produce a valid hour of ozone data. With the exception of the mountain top sites it is recommended that all site activities that require the ozone monitoring system to be taken off line or out of the ambient air sampling mode be completed before 9:12 am. The **9 am hour** has a high probability of being included in the maximum daily 8-hour average concentration each day, so only on Code Green or low Code Yellow forecast days should site activities extend beyond 9:12 am. At the mountain top sites, operators are encouraged to use the 1:00 pm hour and the first 12 minutes of the following hour. See page72.

4.0 OZONE MONITORING SITE VISITS AND DOCUMENTATION AND INSPECTION

The Initial Step during all ozone site activities is the performance of the Site Inspection and Documentation of the ozone monitoring system and equipment. This critical inspection can detect if site adjacent activities are possibly impacting the ambient air samples being collected and analyzed. This Documentation establishes the essential record that links all equipment located at each specific site to additional records located at the Electronics and Calibration Branch (ECB) on Maywood Avenue and the Projects and Procedures Branch (PPB) located at RCO on 217 W. Jones St.

The **Ozone Monitoring eLog workbook is the essential record that documents the performance of the ozone monitoring system and <u>All</u> site operator activities.** It is the site operator's responsibility to ensure that the logbook is accurately and thoroughly completed. The first section of the logbook is the **Site Documentation Section.**

4.1 Site Visit

When driving up to the site, observe the outside of the sampling building looking for vandalism, security breaches, and the presence of unauthorized personnel. **<u>If the operator has any concern for personal safety the operator should not proceed with the site visit.</u>** The site operator should not confront unauthorized personnel that may be present but instead should notify the local police. If there is any evidence of vandalism contact the local police department and DAQ RCO before proceeding further with site activities. Also note the activities adjacent to the sampling site such as construction, paving of highways, timbering, farming etc. and document these observations in the logbook. Comments on observations should be made in the comments section of the documentation page.

Note: It is recommended to open the elog workbook **first** upon sign in and have it ready to populate with site activities before proceeding with any other Envidas activities.

With the new Envidas data system, logging in to the computer has been modified and is as follows to access the elog workbook and active data acquisition files:

Upon entering site building, log in to site computer with your Personal EADS Username and your Personal EADS Password (if necessary). Next to log into the Envidas software use your personal Envidas Username and Personal Envidas Password.

Note: Due to current IT requirements, we are no longer allowed to use Site ID or Site Passwords to log in!

Next, go into Envidas and change /mark the Channel. To achieve this, log into **Envidas Viewer** (operator specific Username and Password) open the **Tabular site view**, and right click on the **pollutant** you will be working with, i.e. **O3** and select an appropriate **channel flag** in the drop-down menu (maintenance, calibration, etc.). Next, set a timer for the flag (recommend "1" hour at a **minimum** depending on your site visit). It is also recommended that the operator open an elog workbook **prior** to logging in and starting any work. If the visit is a routine filter change and abiding by the 9/12 rule, then you want to be as efficient as possible with your time and downed channel(s).

The following data is entered on the **Documentation Page** of the **Ozone Logbook:**

EXAMPLE ONLY

DOCUMENTATION WORKSHEET COMPLETION

Date	Date of the Site Visit	**5/4/2017**
Site	Site Name	**Millbrook**
Operator	Site Operator Name	**J. Doe**
Site Visit Purpose	Choose Activity (Check box)	**Onsite-Cal Check**

Step	Item	Enter	Example Only
1.	**Site Temperature**	DAS Temperature from the monitor	**"20.3"**
	NIST Temperature	(mineral thermometer temp.)	**"20.5"**
	HOBO Temperature	**As is,** on face of HOBO thermometer	**"20.2"**
	Additional Instructions	Required site temperature is **5-40º C**; if not, temperature must be adjusted prior to all site activities.	

Must check HOBO temperature **before** plugging HOBO into computer (plugging in to computer can actually elevate the internal temp. in HOBO causing false display). Refer to **RCO Guidance Documents** under the Documents section on NC DAQ's Ambient Monitoring SharePoint page for instructions.

2.	**Ozone conc.** and **Site Time**	Record Ozone concentration (ppb)	**"55.3"**
	Additional Instructions	If ozone concentration is > 59 ppb downing of the channels may create a False Exceedance	
	Record Site Time(s)	**Computer clock** (DAS) Time	**"8:15"**
		49i time (should be the same as DAS)	**"8:15"**
		(home>>page to Main menu>>inst. Controls>>Date/time)	
		NIST time (nist.time.gov)	**"8:15"**
		HOBO Launch time*	**"8:16"**
	Additional Instructions	NIST and DAS time should be within +/- 1 minute; if not contact ECB. If 49i time is >+/- 1 min. different from DAS, contact ECB	

*The HOBO time is merely the recorded time that the HOBO system was relaunched. The HOBO time can be launched either at the beginning or end of the site visit, but must be saved and launched at least **once per month** to avoid losing potentially essential back-up data.

3. **Site Inspection**

Site Secure (Y/N) **"Y"**
Change in Activities around site (Y/N) **"Y"**
Sample Line, Probe, and Funnel Intact (Y/N) **"Y"**
Moisture or Debris in Sampling Line (Y/N) **"N"**
Heat tape on probe line working (Y/N); ECB contacted

Detail Inspection Exceptions in the comment Section of Logbook **Documentation** page

Solar Radiation Sensor (if applicable)
Is the sensor secure (Y/N/UNK) **"Y"**
Does the sensor face skyward (Y/N/UNK) **"Y"**
Is the Senor Face Clean (Y/N/UNK) **"Y"**
Sensor Face Cleaned during Visit (Y/N) **"N"**

Detail Radiation Sensor issues in Comment Section of logbook Documentation page

4. TEI 49i Ozone Monitor Record Monitor **ID Number** in Logbook **"47"**

- Are Alarms Displayed on the Monitor Screen (Y/N) **"Y"**
- If Alarms are Displayed, Press the **Menu** Button
- Scroll down and Highlight Alarms and press **Enter**
- Record Alarms in Logbook **"Flow"**

Note: If Alarms are displayed Detail and Contact ECB and PPB

TEI 49i Ozone Monitor Operational Limits	
Bench Temp	**5° C - 50° C**
Bench Lamp	**50° C - 60° C**
Ozone Lamp	**65° C - 75° C**
Pressure	**650 - 850 mm Hg**
Flow Cell A & B	**0.5 -1.6 liters per minute (Lpm)**
Intensity Cell A & B	**45 -150 KHz**

Example (cont.)

- Press the **Menu** button
- Scroll Down and Highlight **Calibration Factors** and press **Enter**
- **Record Ozone BKG Factor** in ozone Logbook **"0.3"**
- **Record the Ozone Coeff** in the ozone logbook **"1.03"**
- Press the **Menu** Button
- Scroll down and **Highlight Diagnostics** and press **Enter**
- Scroll down and **Highlight Intensities** and press **Enter**
- **Record Lamp Intensity Cell A** in Logbook **"81200"**
- **Record Lamp Intensity Cell B** in Logbook **"81150"**
- Press the **Menu** Button
- Scroll down and **Highlight Diagnostics** and press **Enter**

- Scroll down and **Highlight Cell Flows** and press **Enter**
- **Record Cell A Flow** in Logbook **"0.610"**
- **Record Cell B Flow** in Logbook **"0.612"**
- Record Sample Line **Installation Date** in Logbook **"3/1/2015"**
    - **Note: The sample Lines are replaced every 2 years**
- **Record Sample Line Length** in meters in the Logbook **"7 m"**

The Documentation Worksheet of the Ozone Logbook then Compares the Sample Flow and the Sample Line Residence Time to Acceptance Criteria.

- **Sample Cell Flow** acceptance criteria between cells is **"+/- 0.1 lpm"**
- **Total Sample Flow** through both cells must be between **"1.0 – 1.6 lpm"**
- **Maximum Sample Line Residence** Time is **"20 Seconds"**

Note: The **EPA** has a **maximum sample line residence acceptance criteria** of **20 seconds**. The table below illustrates sample line (5/32" ID) residence time at 1.0 and 1.5 lpm flow rates for various lengths of sample tubing.

Sample Tubing (meters)	Residence Time (Seconds) at Flow Rates	
	Flow Rate = 1.0 lpm	Flow Rate = 1.5 lpm
5	3.7	2.5
10	7.5	5.0
15	11.2	7.5
20	14.9	10.0
25	18.7	12.4
26	19.4	13.0
40		19.9

Note:
Less than 20 seconds Residence time is required
At a Flow Rate of 1.0 lpm the maximum sampe tube length is 26 Meters
At a Flow Rate of 1.5 lpm the maximum sampe tube length is 40 Meters

Note: The **Federal Equivalent Method (FEM) Designation** for the **Thermo 49i Ozone Monitor** is at a total flow rate between **1.0** and **1.6** lpm

If the Sample Cell Flow or Total Sample Flow or Sample Line Residence Time **Does Not Meet Acceptance Criteria.** The operator actions are:

Action 1: **Notify ECB and PPB**

Action 2: If the site activity is a "**Calibration**" the operator should not proceed with the calibration until the instrument flow problem is resolved or repaired. The monitor should be placed in 'standby' or put offline if not resolved.

Action 3: If the site activity is an "On-Site Manual Performance Check" the operator should proceed with ONLY the On-Site Manual Performance Check after Notifying ECB and PPB of the monitor flows or sample residence time failing acceptance criteria. Following the On-Site Manual Performance

Check the monitor should not be returned to the sampling ambient air but instead left offline.

Action 4: If the site activity was to "Change and Condition the Particulate Filter" the operator should not proceed with the change and conditioning of the particulate filter but instead should first **Notify PPB and ECB** of the failure and then perform an **On-Site Manual Performance Check**. Following the On-Site Manual Performance Check the monitor should not be returned to sampling ambient air but instead left offline.

			Example Only
5.	**49i Transfer Standard**	ID Number	**"41"**
		Certification Date	**"2/23/201**3"
		Alarms displayed	**"Y"**
		Cooling Fan Filter Clean	**"Y"**
	Additional Instruction	The flow Alarm should be Displayed upon Arrival All other Alarms - Contact ECB and/or PPB	
6.	**Zero Air Supply**	ID Number	**"42"**
		Certification Date	**"2/15/2013"**
		Dew Point Sensor Light (Red or Green)	**"Green"**
		Pressure Gauge (20-30 psi)	**"Y"**

Note: If Dew Point Sensor Light is Red – Notify ECB and PPB

7. HOBO Time and Data Download **"Y/N**

Additional Instructions HOBO Temperature data must be downloaded and saved into a secure file share **once per month** (this is now the back-up temperature data for the site)

Revised Time Sync (Relaunch) **"Y/N"**

Additional Instructions Once the HOBO data is downloaded and HOBO relaunched, this will synchronize the HOBO time with the DAS computer time. The Y/N will serve as a check to confirm that the HOBO and DAS times are now synchronized. If they do not sync after relaunch, contact the ECB. Refer to **RCO Guidance Documents** under the Documents section on NC DAQ's Ambient Monitoring ***SharePoint*** page for instructions.

8. Operator Comments. The section is for recording any site-specific observations and problems in accomplishing the task associated with the operation of the ozone monitoring system.

9. Regional Ambient Monitoring Coordinator Comments This section is for review comments and discussion.

5.0 DETAILED PROCEDURES

5.1 Ozone Monitor Calibration with Multi-Point Verification

The Ozone Monitor Calibration establishes the starting point for all data collected and reported at each site. This is the critical link in the chain that connects all ozone concentration data collected and reported from each site to the North Carolina Standard Ozone Photometer.

A **calibration** with a multi-point verification is required once every 365 days and 1/ calendar year regardless of monitor performance.

Throughout the ozone monitoring season performance checks are conducted on the ozone monitoring system. If the system fails these performance checks or if maintenance and repair or replacement of instrumentation is required then the operator must conduct an On-site manual performance check, which must include a **zero (0 ppb)**, **precision (65 ppb)**, and **span (225 ppb)** test points to demonstrate the system is operating within the required performance standards. If critical components (**Calibrator, Monitor, Zero Air Supply**) are changed at the monitoring site or major system maintenance (cell cleaning, solenoid replacement, lamp replacement, pump replacement, scrubber replacement, and sample lines in the calibration pathway or internal to the instruments are changed) then a **calibration with multi-point verification** is required. If electrical power is lost for less than **72** hours no action is required unless the next Precision/Zero/Span (PZS) fails. If the electrical power is lost for more than 72 hours, then an On-Site manual performance check is required to re-establish the link to our state transfer standard. If that check fails to meet acceptance criteria, then a calibration with multipoint verification is **required**.

To be clear; A **Calibration with Multi-Point Verification** is **required** on: i.) **Install;** ii.) **Major component replacement;** iii.) **Equipment swaps** (i.e. ZAP, Calibrator, Monitor); and iv.) **When an On-Site Manual Performance Check fails** to meet the site operation standards.

The **Ozone Monitoring Logbook is the essential record** that documents the performance of the ozone monitor calibration and all site operator activities. It is a critical document in evaluating the quality of the data collected and adherence to approved procedures at each site. It is the site operator's responsibility to ensure that the logbook is accurately and thoroughly completed. The Initial Step in all site activities is to complete the **Site Documentation Section** of the Ozone Logbook (Section 4.0 of this SOP).

The Calibration with Multi-Point Verification Worksheet of the Ozone logbook is included on Page 76-77 of this document.

In order to avoid confusion, the following table will verify the nomenclature utilized in Envidas/Envista software to understand the relevant Span Levels for Ozone:

Envista software	Calibrator	Level	Comment(s)
Span	**225 ppb**	**Level 4**	
Span 4	**180 ppb**	**Level 5**	**New for 2020 season**
Span 3	**120 ppb**	**Level 3**	
Span 1	**65 ppb**	**Level 2**	
Span 2	***50 ppb***	**Level 1**	***not currently used***
Zero	**0 ppb**	**Level 6**	

Section 5.1.1 Log into the Site Data System: Envidas

- Log in to site computer with Personal **EADS ID** and your **Personal Password** (as necessary),
- Log into Envidas **Viewer** and enter your personal Envidas Username and Envidas Password (operators personal)
- Right click on the pollutant you will be working with, i.e. O3 and Set channel flag in the Drop down menu to "**Maintain**" or **Calibrate**, or etc.,
- Specify duration (recommended <u>at least</u> **1 hour** depending on site visit type),
- Enter **Force Now** to activate.
- Open elog workbook (If not already opened)
- Document all relevant information on Documentation Tab including time(s), temperatures, type of visit, and etc. (Please be thorough with any/all site activity information!).
- Proceed to relevant site visit type Tab (i.e. **Maintenance**, **Calibration, etc.**)

Section 5.1.2 Calibration Particulate Filter *Installation* and *Conditioning* Procedure

A Leak check **must** be performed **before** the filter change, regardless of the reason for changing the filter. This will help bracket suspicious data, anomalies, or other issues which could occur outside of normal monitoring activity. A Leak check **must** be performed **after** the filter change as well. Both leak checks must be documented on the **Calibration worksheet** (Column F, cells 13 and 14).

Particulate Filter Conditioning prior to the performance of all Ozone Monitor Calibrations is a very critical step. A new Teflon particulate filter **MUST** be installed and conditioned prior to proceeding with the calibration procedure.

It may be necessary to perform a second or even third filter conditioning cycle to ensure the filter is completely conditioned. (**Note:** if too much drift from Acceptance Criteria is observed, then allow more time to stabilize before proceeding; a bit of patience could improve the resultant values)

Filter Conditioning Procedure Acceptance Criteria for Calibrations

iPS (calibrator)	49i (analyzer)
Span: 225 ppb +/- 2 ppb	Span: 225 ppb +/- 5 ppb
Zero: 0 +/- 2 ppb	Zero: 0 +/- 3 ppb*

The Acceptance Criteria has 2 components a Level such as 225 ppb and 0 ppb and a Range of acceptability at those levels of 5 ppb and 3 ppb, respectively. The Ozone Reading at the Monitor is expected to achieve between 220 to 230 ppb and +3 to -3 ppb* rapidly due to two factors. The first being the initial site setup by the ECB Staff and the high quality particulate filters now available.

The added consideration during filter conditioning for a Calibration cycle is the filter **MUST** be conditioned and the readings **MUST be stable** (i.e. within 1 or 2 ppb consecutive values without deviation/fluctuation) prior to the recording of 5-one minute values in the filter Conditioning Section of the Calibration Worksheet. Copy and paste the 5 one-minute values by querying the site PC's sequel database using the EnviDas Reporter module and creating a site report (Reports – Sites – Channels) and displaying it in Excel format. At the end of the site visit, all of the minutes are ***Required*** to be pasted onto a 'minutes' tab/worksheet (excel) in the workbook. This procedure can be found in **Appendix B, RCO Guidance Documents, under the Documents section on NC DAQ's *SharePoint* web page.**

Additional Instructions — The channel(s) will already have been downed at this point in the process via the Envidas procedures and time(s) and temperature(s) should have already been documented in the elog workbook.

Filter Change Procedure

- Run a **Pre-Leak** check prior to changing the filter by disconnecting the filter line to the 'Common Solenoid port on the back of the Monitor and capping the port as well as the filter 'open line'. Press the **Menu Button** on the front of the TEI 49i Ozone Monitor and select **Diagnostics** and then select **Pressure** (also see procedure 1 thru 7 below)
- Disassemble the filter holder with the filter disassembly wrenches provided.
- Remove the existing filter and inspect the filter support screen.
- If the filter support screen is dirty rinse with de-ionized water and then dry.
- Reinstall the filter support screen.
- Touching only the outer edge of the new filter place the filter in the holder.
- Reassemble the filter holder. DO NOT OVER TIGHTEN THE FILTER HOLDER; THIS CAN TEAR THE FILTER AND/OR DAMAGE THE FILTER HOLDER.

Perform a Leak Test on the 49i after changing the Filter

Press the **Menu Button** on the front of the TEI 49i Ozone Monitor

- Select "**Diagnostics**" then select "**Pressure** "
- Disconnect the Ambient input line from the back of the analyzer and plug the opening with a plastic insert. (This will check not only the filter, but the whole system for leaks).
- The pressure should decrease below 250 mm Hg within 60 seconds (usually much faster).
- **If pressure does <u>not</u> drop there is a leak**. Remove the Ambient Inlet plug fitting and check all fittings and check the input lines for cracks and correct as necessary (sometimes the replacement of an additional filter will solve the problem)
- Repeat leak test. If it fails, contact ECB for assistance in correcting leaks.
- If leak corrected and test is passed reattach the ambient input line to the filter holder.
- Press Run and continue with filter conditioning.

Particulate Filter Ozone *Conditioning* Procedure (Record in the Calibration worksheet)

Note**: During Season Opening Calibration**, the new particulate filter should be conditioned a minimum of **30-45 minutes**. This helps burn off any potential contaminants that may react with the ambient air via the inlet probe.

Begin by running a **SPAN** test (225 ppb)

- in Envidas VIEWER, select [**Operational**].
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.

- Select **SPAN**
- Check duration to "**01:00:00**". [The Operator can set a longer duration to prevent interruption during a longer procedure which may take more than an hour to perform (i.e. **Calibration**)]
- Hit **Start** (phase will show countdown and start at the top of the minute)
- View progress of burn in **Viewer** >> **Dynamic** >> **Charts**>> **Ozone** (you can also view the face of the analyzer to monitor the progress of the filter burn)

The **Span** Event (225 ppb Ozone—**Level 4**) will start and run in order to begin conditioning the particulate filter.

When the Ozone Readings Meet the Acceptance Criteria (**225 ppb +/- 5 ppb**) and are Stable then record 5 x 1-minute average ozone concentrations in the elog workbook.

Open **Reporter** (Envista/Envidas)
Note: If the readings do not stabilize at a level that meets the acceptance criteria, replace the Filter, leak check, and repeat. If a second filter conditioning does not stabilize, contact the ECB or PPB.

Particulate Filter Ozone *Conditioning* Zero Point Procedure (Record in Calibration worksheet of elog workbook).

Next, Abort the Span Event and begin the **Zero Point Procedure**

Hit the **Abort selection** to end the Span check and get ready to start the **Zero Point**.

Note: Be sure to **use Abort** command and **not** the **Stop** command. The Stop command will end the sequence and we want to proceed with the next point(s).

Section 5.1.3 Calibration Zero Begins: Testing Phase

Note: You **must** Calibrate the Zero **first** when performing a **Calibration**!

- Begin by running a **ZERO test** (0 ppb)

- in Envidas **VIEWER**, select [**Operational**].
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select **ZERO**
- Check **duration** to "**01:00:00**". (Recommended to set it longer (2 hours) to prevent premature aborting of sequences): Recommended to allow to stabilize at least **30-45** minutes
- Hit **Start** (phase will show countdown and start at top of minute)
- View progress of burn in **Viewer** >> **Dynamic** >> **Charts** >> **Ozone**

Once Stabilized (45 min.), then proceed as follows:

When the Zero Point Ozone Readings Meet the Acceptance Criteria, enter 5 -1` minute concentrations into the elog workbook. These reading will be pulled from Envista Reporter (copied and pasted into an Excel worksheet to assure they match exactly minute for minute with the DAS system.

The ozone logbook data Calibration boxes will calculate the average for the values entered and compare the average values to the Acceptance Criteria. The Operator and the Logbook will evaluate the Filter Conditioning Data acceptability. The Filter Conditioning Acceptance Criteria are:

iPS (calibrator)	O3 (monitor)
0 ppb (+/- 2ppb)	0 ppb (+/- 3 ppb)
225 ppb (+/- 2ppb)	225 ppb (+/- 5 ppb)

If these **acceptance criteria** are **not** satisfied **it is recommended to discuss with PPB and ECB.**

Adjustment of Zero and Span

If the acceptance criteria are satisfied, you have successfully conditioned the filter and performed the post leak check and are ready to start the ***Adjustment* Phase** of the Calibration. This will involve **adjusting** the **Zero** (O ppb) point and the **Span** point (225 ppb) and then testing the linearity with 3 successive check/verification points (180 ppb, 120 ppb, and 65 ppb). Per EPA request, we will also run a regression analysis with curve following the linearity check. This part of the procedure is new and will not involve any extra key-strokes by the operator. **The data table for the Regression should auto-fill once the 5 points of the Adjustment and Verification phases are completed and entered into the elog workbook**.

You are now ready to Adjust the Zero point.

NOTE: Be sure and copy and post all minute data in the 'minutes' worksheet of the elog workbook! This data is imperative to prove numerical agreement with the checks and the calibration data.

Section 5.1.4 Calibration of the Ozone Monitor (step 3 in elog workbook Calibration worksheet)

This is the **Adjustment Phase** of the **Zero Point** in the Calibration Multi-Point Verification

The TEI 49i Ozone Monitor needs to be Unlocked

- Press The **soft** key under Password
- Press the **Enter** to unlock instrument

- For Password press **Enter** key once slowly
- Press the **Menu Key** once to Display the main **Menu Options**
- Use down Arrow to highlight **Calibration** and Press **Enter**
- Once the **0 Event** has stabilized, then Down Arrow to highlight **Cal Zero** and Press **Enter**
- Press **Enter** again to calibrate the **Zero**.
- Press Run to return to main screen (if stability is achieved)

The Zero Span Event (0 ppb Ozone) should run until stable (**5-10** minutes to confirm stability).

- **Record 5 x 1 minute readings from the iPS and O_3 channels in the ozone logbook**

The ozone logbook macro calculates the average of the 5 x 1-minute values. The Operator and Ozone Logbook compare the Average Readings to the Data Acceptance Criteria and determine the acceptability. The Acceptance Criteria for the average ozone concentration readings are below.

iPS	O3
0 ppb +/- 2ppb	iPS +/- 2ppb

  - If the Zero Calibration Point DOES NOT meet data Acceptance Criteria, check the sample line connections from the calibrator and Re-run the Zero Calibration Point. If the Zero Calibration Point fails the 2nd attempt, contact PPB and ECB!

To end the **Zero Adjustment** event, Press the **Abort** key to stop the process.

You are now ready to begin the SPAN (225 ppb) Level 4 Adjustment step of the Calibration.

Level 4, SPAN, (225 ppb) Event Calibration Procedure (Full Span 225 ppb step 3 in elog workbook Calibration worksheet)

Begin by running a **SPAN (**Level 4**) test** (225 ppb)

- in Envidas **VIEWER**, select [**Operational**].
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select **SPAN**
- Set duration to "**01:00:00**".
- Hit **Start** (phase will show countdown and start at top of minute)
  - **View progress of Calibration in:** ***Viewer >> Dynamic >> Charts>> Ozone***

The Level 4 **Span Event (225 ppb Ozone) will start and run until stability is observed**. This will normally take 30-45 minutes to achieve, but may take longer with some instruments. Please be patient and allow ample time to stabilize for a **Calibration** procedure.

Allow the readings to stabilize

- Press the **Menu Key** to Calibrate the level 4 **SPAN** Event (225 ppb)
- Select the **Calibration O3 Coefficient. Then** the Calibrate O3 screen should be displayed. The Span Concentration displayed is **000000225**.
- Press **Enter** to **Calibrate (the SPAN 225 ppb)**
- Press **Run** to return to the Main Run Screen
- **Record 5 x 1 minute readings from the O_3 and O_3CAL channel in the ozone logbook**.

The ozone logbook calculates the average of the 5 x 1 minute values. The Operator and the Ozone Logbook compare the Average Readings to the Data Acceptance Criteria and determines the acceptability. The Acceptance Criteria for the average ozone concentration readings are below.

iPS (calibrator)	O3 (monitor)
225 ppb +/- 2 ppb	iPS (cal) +/- 2 ppb

If the **SPAN** (225 ppb) Calibration Point DOES **NOT** meet the Data Acceptance Criteria as determined by the Ozone Logbook, the operator should check the sample line connections from the calibrator to the ozone monitor and Re-run the Zero and SPAN Calibration Procedure. If the Zero and or SPAN Calibration Point FAILS to PASS the second calibration cycle, contact PPB and ECB.

If the SPAN Calibration Point PASSES the Data Acceptance Criteria, proceed to the Review of the Ozone **Span Coefficient Calibration Factor** and ozone **Background Factor**.

Record the 49i Monitor **Ozone Span Coefficient Calibration Factor** and the **Ozone Background Factor** in the **Ozone Calibration Worksheet. The Acceptance Criteria** for the **Calibration Factor** is **0.95 - 1.05** and the **Background Factor Acceptance Criteria is -3 - + 3.**

- Press the **Menu Key** to display the 49i menu.
- Press the **Down Arrow** to Highlight the **Calibration Factors**
- Press the **Enter Key** to select **Calibration Factors**
- **Record** the **Calibration Factor** and the **Background Factor** in the Logbook
- The **Ozone Logbook will Evaluate** the **Ozone Coeff** and the **Background Factors**

Note: If the Ozone Coefficient is **Greater than 1.05,** a **leak** is suspected**.** The following action list is required to be performed:

- All fittings should be checked. This includes all fittings and connectors on the ozone monitor and the ozone calibrator.
- A leak test should be performed.
- The **ZERO** and SPAN Calibration procedures above should be Repeated.
- If the Ozone Coefficient is greater than **1.05** after the second attempt to calibrate the ozone monitor, the operator should contact ECB and PPB

If the **Ozone Coefficient** is Less Than **0.95,** the C**alibration** (Zero and SPAN) should be repeated. If the second attempt to calibrate fails to meet acceptance criteria, the operator should contact ECB and PPB.

If the Ozone Span Coefficient PASSES Acceptance Criteria, proceed below and perform the Calibration Curve Verification at Level 5 (180 ppb), Level 3 (120 ppb), and Level 2 (65 ppb)

You will have now completed the **Adjustment phase of Zero and Span** (225 ppb) and will proceed with **Verification phase** of **180** ppb, **120** ppb, and **65** ppb!

Press **Run** to return to the Run Screen

To **Stop** the **Level 4** (225 ppb) **Adjusted SPAN** Event and **Start** the **Level 5 Multi-Point Curve Verification (180ppb) Event:**

- To end the Level 4 (225 ppb) Event Hit the **Abort** key to stop the process

  Note: the STOP key will only Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Level 5 (180 ppb) Event Calibration Curve Verification Procedure

Begin by running a **SPAN 4 (Level 5)** test (**180 ppb**)

- in Envidas **VIEWER**, select [**Operational**].
- Select [**Phase from Sequence**]
- Select **[O3MAN]**.
- Select **SPAN 4**
- Set duration to "**01:00:00**".

- Hit **Start** (phase will show countdown and start at top of minute)
- View progress in **Viewer >> Dynamic >> Charts >> Ozone**

The Span 4 (Level 5) Event (180 ppb Ozone) will start and run until stability is observed and recorded in the elog workbook.

Record 5 x 1 minute readings from the O_3 and O_3CAL channels from the Envista Reporter Excel worksheet in the ozone elog workbook.

The Calibration Curve Verification Data Acceptance Criteria for the Level 5 Event are:

iPS (calibrator)	O3 (monitor)
180 ppb +/- 2ppb	**iPS +/- 2 ppb**

The Ozone Logbook macro calculates the average of the 5 x 1-minute concentration values for the **Level 5 (180 ppb**) Event. The Operator will compare the results in Logbook entries to evaluate the data versus Acceptance Criteria.

If the **Level 5 (180 ppb**) Event data **PASSES** Acceptance Criteria, proceed and perform the **Level 3/Span 3 (120 ppb)** Event. If the **Level 5** Event data **FAILS the data acceptance criteria,** <u>then **RE-RUN the Level 5 Event and patiently allow time to stabilize**</u>**. If the Level 5 Event FAILS the second evaluation, contact ECB.**

To Stop the Level 5 (180 ppb) Event and Start the Level 3 (120 ppb) Event:

- To end the **Level 5** Event Hit the **Abort** key to stop the process

Note: the STOP key will <u>only</u> Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Start The Level 3/Span 3 (120 ppb) Event.

- Begin by running a **SPAN 3 (Level 3)** test (**120 ppb**)
- In Envidas **VIEWER**, select [**Operational**]
- Select [Phase from Sequence]
- Select **[O3MAN]**.
- Select **SPAN 3**
- Set duration to "**01:00:00**".

- Hit **Start** (phase will show countdown and start at top of minute)

- View progress in **Viewe**r **>> Dynamic >> Charts >> Ozone**

Once the readings stabilize record the Level 3 (**120 ppb**) Event concentrations Readings from Envista Reporter in the Ozone Logbook.

The Calibration Curve Verification Data Acceptance Criteria for the Level 3 Event are:

iPS (calibrator)	O3 (monitor)
120 ppb +/- 2 ppb	**iPS (cal) +/- 2 ppb**

The Ozone Logbook calculates the average of the 5 x 1-minute concentration values for both the Level 3 (120 ppb) Event. The Operator uses the Logbook calculations to evaluate the data versus the Acceptance Criteria.

If the Level 3 Event data **FAILS** the data acceptance criteria, then RE-RUN the Level 3 Event. If the Level 3 Event FAILS the second evaluation, contact ECB.

To Stop the Level 3 (120 ppb) Event and Start the Level 2 (65 ppb) Event:

- To end the Level 3 Event Hit the **Abort** key to stop the process

Note: the STOP key will <u>only</u> Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Start The Level 2/Span 1 (65 ppb) Event.

- Begin by running a **SPAN 1 (Level 2)** test (**65 ppb**)
- In Envidas **VIEWER**, select [**Operational**]
- Select [Phase from Sequence]
- Select **[O3MAN]**.
- Select **SPAN 1**
- Set duration to "**01:00:00**".
  - Hit **Start** (phase will show countdown and start at top of minute)
- View progress in **Viewe**r **>> Dynamic >> Charts >> Ozone**

Once the readings stabilize record the Level 2 (**65 ppb**) Event concentrations Readings from Envista Reporter in the Ozone Logbook.

The Calibration Curve Verification Data Acceptance Criteria for the Level 2 Event are:

iPS (calibrator)	O3 (monitor)
65 ppb +/- 2 ppb	**iPS (cal) +/- 2 ppb**

The Ozone Logbook calculates the average of the 5 x 1-minute concentration values for both the Level 2 (65 ppb) Event. The Operator uses the Logbook calculations to evaluate the data versus the Acceptance Criteria.

If the Level 2 Event data **FAILS** the data acceptance criteria, then RE-RUN the Level 2 Event. If the Level 2 Event FAILS the second evaluation, contact ECB.

If any of the Intermediate Calibration Curve Verification Points (180 ppb, 120 ppb, and 65 ppb) FAILS the Calibration Curve Data Acceptance Criteria but the Adjusted Zero Event (0 ppb) and the Level 4 Adjusted SPAN (225 ppb) PASSES data acceptance criteria, then a complete Calibration Procedure including the change and conditioning of a new Particulate Filter must be performed before the ozone monitor can be considered to meet ambient air data reporting criteria. This is the Calibration that represents alignment with the transfer standard for the seasonal data. If the monitor fails any aspect of this 2nd Calibration Procedure, contact both the PPB and ECB**!**

If the results of the analysis of all intermediate points (180 ppb, 120 ppb and, 65 ppb) PASS the Data Acceptance Criteria, the ozone monitor has now been Calibrated and verified with multiple upscale points. Proceed below and "Up" the Monitor Channel(s) and the monitor will then begin reporting ambient air ozone concentration data.

To end Level 2 (65 ppb), hit the **Abort** key. Allow **2-3** minutes for the instrument to stabilize to ambient ozone levels before proceeding. Next, up the data channels (reset the flag).

Once you have **Successfully** completed **Steps 3 through 5 in the elog** workbook (the 5 Point calibration Curve) and have returned the monitor to Lock (data retrieval) mode, **Step 6 (in the elog workbook),** then proceed to scroll down the elog Calibration worksheet to **Step 7 in the elog workbook---Ozone Monitor Verification/Calibration Assessment**. If everything is entered into the elog workbook appropriately, then this section should be auto-populated with the **Linear Regression** of the calibration data entered in steps 3 through 5 above.
The limits for the slope should fall between **0.95 to 1.05**, and all entered values in Steps 3 through 5 above should fall within **+/- 2 ppb** of the relevant Acceptance criteria ranges (i.e. 225 +/- 2 ppb, 180 +/- 2ppb, 120 +/-2 ppb, 65 +/- 2ppb).

*If desired, the operator can add the **slope/intercept equation** and **R^2** value onto the graph face after completing the curve by following the direction in the text box below the graph (optional).

Once you are certain everything is completed then you are ready to Up (reset) the channels as indicated below:

Up the Monitor Data Channels (reset flag)

Once all data points have been tested and recorded for Calibration, then the operator will unflag/up the channels

- **Go to Viewer Dynamic tabular**
- Right click the channel in the Tabular display
- In the options box, select the **Set Channel Flag**
- Select **Reset Flag** (at the top of the dropdown list)
- The instrument status should now change to "**OK**"
- The other marked channel(s) will follow suit as their respective average times is/are satisfied (i.e. 1 min., 5 min., and etc.)
- The channel(s) is/are now up and the Calibration procedure is complete
- Once the calibration is completed, the Operator should generate an Excel data spreadsheet capturing all data recorded during the visit and highlight the relevant 'points' generated and times captured. This information will then be cut and pasted into the **DAS Minutes tab** in the Ozone eLog workbook (also see detailed process in Share Drive procedures, ***SharePoint***).

5.2 Precision/Zero/Span (PZS) and Precision Point Analysis.

Daily Auto-PZS Checks and Precision Point Analysis are programmed to occur automatically each day during periods of time when the ambient air ozone levels are the lowest. At the mountain top sites this check occurs at 12 noon each day and at the lower elevation sites this occurs at 3 am each day. The Daily Auto-PZS Check and Precision Point Analysis is the ongoing ozone monitoring system performance evaluation that enables the reporting of the highest quality data possible. The Daily Precision Point Analysis, also known as the **Single Point QC check** results, which are **"Reported to the EPA"** as an ongoing measurement of the quality of the ozone concentration data produced at each site. Starting January 1, 2020, RCO and Site Operators and Regional Ambient Monitoring Coordinators will not only observe the Zero and Span points, but these points will also be reported to AQS and the EPA. The Zero and Span are good daily indicators on how the monitor is performing on a day-to-day basis and often help with preliminary troubleshooting should 'out of range' values occur.

The Daily Auto-Calibration and Precision Check Analysis Data Acceptance Criteria are:

Theoretical Concentration	iPS (calibrator)	O3 (monitor)
0 ppb	**0 ppb +/- 2 ppb**	**iPS +/- 2 ppb**
65 ppb	**65 ppb +/- 3 ppb**	**iPS +/- 3 ppb**
225 ppb	**225 ppb +/- 3 ppb**	**iPS +/- 5 ppb**

The Daily Auto-PZS Check Results Report MUST be Reviewed Daily. The results of this daily performance check are compared to the Data Acceptance Criteria by the site operator, the regional chemist, or a designee. **This critical review MUST occur as the first daily activity throughout the ozone monitoring season.** This early review enables any required on-site investigations and performance evaluations to occur as early in the day as possible. The earlier the site visit the fewer the number of hours of valid ozone data that will be potentially lost during

the higher ozone levels normally experienced during the middle of the day at our sites. This early review can also reduce the time required if additional assistance or replacement equipment is needed to return the ozone monitoring system to reporting acceptable ambient air ozone concentration data. An example of the Daily Auto-PZS and Precision Point Analysis and Site Temperature Evaluation report is shown below

If the Daily Auto PZS and Precision Point Analysis **FAILS the Acceptance Criteria, an investigation is warranted. It may require an In-Office Manual Performance check, an Inspection and/or Site Visit, and/or On-Site Manual Performance Check depending upon the circumstances.**

If the results of the Daily Auto PZS and Precision Point Analysis **PASS** the **Acceptance Criteria,** then no further action is required based upon the results of the Daily Auto-Calibration and Precision Point Analysis.

Example of Summary Auto-Cal table created by DAQ Statistician for all O_3 sites (sent daily)

Ozone Daily Auto-Calibration Check and Precision Point							*i* Ps Evaluation			Monitor Evaluatio			Temp. Range	Comment	AQI Forecast		Forecast Source
31-Jul-17	*i* Ps			Monitor			Comparison to Expecte			Comparison to CP					Code	AQI	
	Zero	Span1	Span	Zero	Span1	Span	0 ppb	65 ppb	225 ppb				20-30^0 C				
Joanna Bald	0.0	64.0	225.0	0.0	64.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	45	Mtn Top
Frying Pan	0.0	65.0	225.0	0.0	65.0	226.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	45	Mtn Top
Mt Mitchell	0.0	65.0	224.0	0.0	64.0	224.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	45	Mtn Top
Purchase Knob	0.0	65.0	225.0	0.0	64.0	224.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	45	Mtn Top
Linville Falls	0.0	64.0	225.0	0.0	64.0	224.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	46	Valleys
Bryson City	0.0	64.0	225.0	0.0	65.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	46	Valleys
Waynesville	0.0	64.0	225.0	0.0	64.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	46	Valleys
Bent Creek	0.0	65.0	225.0	0.0	65.0	224.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	46	Valleys
Lenoir	0.0	65.0	225.0	0.0	64.0	223.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	47	Hickory
Monroe	0.0	65.0	224.0	0.0	64.0	226.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Moderate	51	Charlotte
Crouse	0.0	65.0	224.0	0.0	64.0	223.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Moderate	51	Charlotte
Rockwell	0.0	64.0	225.0	0.0	64.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Moderate	51	Charlotte
Liledoun	0.0	64.0	225.0	0.0	64.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	47	Hickory
Bethany	0.0	65.0	225.0	0.0	64.0	224.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	48	Triad
Mendenhall	0.0	65.0	225.0	0.0	63.0	222.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	48	Triad
Cherry Grove	0.0	65.0	225.0	0.0	64.0	224.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	48	Triad
Wade	0.0	65.0	225.0	0.0	64.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	47	Fayetteville
Honeycutt	0.0	64.0	225.0	0.0	65.0	225.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	47	Fayetteville
Blackstone	0.0	64.0	225.0	-1.0	63.0	223.0	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Green	47	Fayetteville

5.3 Daily Site Temperature Review

The ozone monitoring shelters must be operated between 5 - 40° C for the ozone concentration data reported by the ozone monitoring system to be acceptable. Each day as part of the early morning review associated with the review of the Daily Auto-Calibration and Precision Point Analysis Review described above, the operator, regional ambient monitoring coordinator, or designee **MUST** review the temperature of the monitoring building for each site. The **Daily Auto-Calibration and Precision Point Analysis and Site Temperature Evaluation report is shown in the table above (Sect 5.2).**

If the monitoring building **FAILS** the **5 - 40º C Temperature Range Acceptance Criteria,** a site visit is **required** to correct the loss of temperature control at the site and reduce the number of hours that ambient air ozone data will be lost. At the beginning of Ozone season and at the end of the season, temperature swings are expected. It is at the discretion of the site operator and Regional Ambient Monitoring Coordinator to determine if a site visit is merited and the potential consequences of loss of monitoring data is to be considered as well.

For **all** site visits including the Site Temperature Control Adjustment the **Documentation Page** of the Ozone Logbook must be thoroughly completed. This includes recording the NIST (mineral thermometer) temperature, the DAS (computer---Comet) temperature, the display on the 49i monitor, and the HOBO temperature (if relaunching the HOBO). Please see **RCO Guidance Documents** under the Documents section on NC DAQ's Ambient Monitoring SharePoint page for instructions and for specific procedures.

The operator should also consider performing a Particulate Filter Change and Conditioning during the Temperature Range Failure site visit. This latter procedure is dependent upon the site operator time availability considering other regional responsibilities and when the particulate filter was last changed.

If the monitoring building **PASSES** the **5 - 40º C Temperature Range Acceptance Criteria,** no temperature related activity is required.

5.4 Daily Reported Ozone Data Review

Each morning as early as possible the site operator, regional ambient monitoring coordinator, or designee **MUST** review the hourly ozone data reported from each ozone site (during normal working hours M-F). This review is to determine if any unusual hourly average ozone concentration values (high or low) have been reported or unusual data patterns are being reported. This review can determine many problems such as electrical power outages, leaking sample lines, possible water condensation in the sample lines, pump failures, a calibrator failure, a monitor lamp failure, and many others. It is the ultimate responsibility of the Site Operators/Technicians to obtain their own data and verify it. Second hand copies could be in error or misleading. The Operators should generate their own unique report(s) and Own the data!

If an unusual hourly average ozone concentration has been reported, a site visit is highly RECOMMENDED to investigate possible causes of the odd or unexplainable reported ozone concentration data. The operator, regional ambient monitoring coordinator, or designee should contact both the PPB and the ECB to discuss their findings and observations during their data review. An example of a *Daily Ozone Polling report* is below:

Date & Time	O3	Status	TMP	Status
	[ppb]		[DEGC]	
8/16/2017 00:00	6	Ok	23.7	Ok
8/16/2017 01:00	7	Ok	23.7	Ok
8/16/2017 02:00	6	Ok	23.7	Ok
8/16/2017 03:00	127	BF - Calib	23.7	Ok
8/16/2017 04:00	7	Ok	23.7	Ok
8/16/2017 05:00	10	Ok	23.6	Ok
8/16/2017 06:00	11	Ok	23.6	Ok
8/16/2017 07:00	15	Ok	23.7	Ok
8/16/2017 08:00	28	Ok	23.8	Ok
8/16/2017 09:00	33	Ok	23.9	Ok
8/16/2017 10:00	35	Ok	24.0	Ok
8/16/2017 11:00	41	Ok	24.3	Ok
8/16/2017 12:00	41	Ok	24.2	Ok
8/16/2017 13:00	43	Ok	23.9	Ok
8/16/2017 14:00	43	Ok	23.8	Ok
8/16/2017 15:00	44	Ok	24.2	Ok
8/16/2017 16:00	43	Ok	24.0	Ok
8/16/2017 17:00	38	Ok	23.8	Ok
8/16/2017 18:00	35	Ok	23.7	Ok
8/16/2017 19:00	29	Ok	23.7	Ok
8/16/2017 20:00	22	Ok	23.6	Ok
8/16/2017 21:00	19	Ok	23.6	Ok
8/16/2017 22:00	25	Ok	23.6	Ok
8/16/2017 23:00	22	Ok	23.5	Ok

Date	StationID	MonitorId	Monitor	Unit	Type	Ref	Meas	Value	Diff%	STD	Status
8/16/2017 04:04	39	4	O3	ppb	Zero	0	2	2	0	0	Valid
					Span	225	226	1.001	0.8	0	
					Span1	65	65	1	0	0	
8/17/2017 04:04	39	4	O3	ppb	Zero	0	0	0	0	0	Valid
					Span	225	226	0.994	0.4	0	
					Span1	65	64	1	0	0	

5.5 Routine Particulate Filter Change and Conditioning

The particulate filter is a critical part of the ambient air sampling system for it protects the ozone monitor from contamination. A new particulate filter must be installed and conditioned prior to all ozone monitor Calibrations and is required every **30 days** throughout the ozone season. The conditioning of the new particulate filter is performance based. When the results of the conditioning cycle **Pass** the Acceptance Criteria, the filter is considered conditioned. The performance of a **Leak test** on the particulate filter holder is now **required** both **prior to** and **after** the particulate filter conditioning step. The prior to check would help bracket suspect data if an anomaly occurs with the instrument.

The installation and conditioning of the particulate filter requires the ozone monitoring system to be taken out of the ambient air sampling and analysis mode.

If during the ozone monitoring season the Air Quality Forecast is Code Yellow with AQI > 65 and the ozone monitoring system has met all of the Data Acceptance Criteria of the Daily PZS Check and Precision Point Analysis and a particulate filter change and conditioning is due, it is recommended that the changing and conditioning of the particulate filter be postponed until the AQI forecast is < 65. If this is not possible due to regional staff schedules and responsibilities, it is recommended that the particulate filter

changing and conditioning be performed following the **9:12 Minute Rule** (i.e. before 9:12 a.m. to be able to capture 75% of before and after visit hours).

If the changing and conditioning of the particulate filter is postponed due to the elevated ozone forecast (AQI > 65), the operator must continue to monitor and evaluate the performance of the Daily Auto-PZS Check and must change and condition the particulate filter as soon as possible when the ozone AQI Forecast is < 65. If the ozone monitoring system fails the Daily Auto-PZS Check during this extended filter use period, an **On-Site Manual Performance Check must be performed** prior to performing the Particulate Filter Change and Conditioning.

The Documentation page of the **Ozone Logbook** must be thoroughly completed as part of the site visit to change and condition a new **Particulate Filter** as well as the **Routine Filter Change** page**.**

The Routine Particulate Filter Change Worksheet from the Ozone Logbook is included on page 78-79 of this document.

Section 5.5.1 Particulate Filter Change and Conditioning Procedure

- Log in to site computer with Personal EADS ID and your Personal Password (as necessary),
- Log into Envidas **Viewer** and enter your Envidas Username and Envidas Password (operators personal)
- Right click on the pollutant you will be working with, i.e. O3 and Set channel flag in the Drop down menu to "**Maintain**",
- Specify duration (recommended at least 1 hour depending on site visit type)
- Enter **Force Now** to activate.
- Open elog workbook
- Document all relevant information on **Documentation Tab** including time(s), temperatures, type of visit, and, etc.
- Proceed to relevant site visit type Tab (i.e. **Routine filter**)
- **Check and Record the Computer Time(s) and Temperature(s)**

Section 5.5.2 Pre-Leak test

Note: It is **Now Required** to Perform a **Pre-leak test** before changing the filter

(this often helps uncover potential issues early on, especially if anomalies have been sporadically occurring at a site.). This process could also help bracket and save suspect data.

- Press the **Menu Button** on the front of the 49i Monitor
- Go to Diagnostics Menu and Select the **Pressure Screen**
- Disconnect the Ambient input line from the sampler input port and plug the line with a plastic plug
- The pressure should decrease below 250 mm Hg within a **minute** or less.
- If the pressure does not drop, there is already an existing leak in the system and this should be noted in the elog workbook as this could affect data review and **data bracketing**
- Proceed with the Filter Change as follows

Filter Change Procedure

- Disassemble the filter holder with the filter disassembly wrenches provided.
- Remove the existing filter and inspect the filter support screen.
- If the filter support screen is dirty rinse with de-ionized water and then dry.
- Reinstall the filter support screen.
- Touching only the outer edge of the new filter place the filter in the holder.
- Reassemble the filter holder. DO NOT OVER TIGHTEN THE FILTER HOLDER FOR THIS CAN TEAR THE FILTER AND/OR DAMAGE THE FILTER HOLDER.

Perform a Post Leak Test on the 49i

- Press the Menu Button on the front of the TEI 49i Ozone Monitor
- On the "Diagnostics Menu" Select **Pressure Screen**
- Disconnect the Ambient input line from the back of the particulate filter holder and plug the opening with a plastic plug.
- The pressure should decrease below 250 mm Hg within 1 minute or less.
- If pressure does not drop there is a leak. Remove Ambient Inlet plug fitting and check all fittings and check the input lines for cracks and correct as necessary
- Repeat leak test. If it fails, contact ECB for assistance in correcting leaks.
- If leak has been corrected and the test passed, reattach the ambient input line to the sample input port.
- Press Run and continue with filter conditioning.

Particulate Filter Ozone Conditioning Procedure Level 4 (225 ppb) Event

- Begin by running a **SPAN** test (225 ppb)
- in Envidas **VIEWER, select [**Operational**]**
- Select [**Phase from Sequence**]
- Select **[O3MAN]**

- Select **SPAN**
- Set duration to "**01:00:00**"
- Hit **Start** (phase will show countdown and start at top of minute)
- View progress of burn in **Viewer** >> **Dynamic** >> **Charts**>> **Ozone**

The Level 4 Span Event (225 ppb Ozone) will start and should run for at least **10** minutes to condition the particulate filter. (It may take longer to stabilize.)

When the Ozone Readings Meet the Acceptance Criteria (225 ppb +/- 5 ppb) and are Stable then record 5 x 1-minute average ozone concentrations in the elog workbook on the **Routine Filter tab**.

Note: If the readings do **not** stabilize at a level that meets the acceptance criteria, replace the Filter, leak check, and repeat. If second filter conditioning does not stabilize, contact the ECB or PPB. At this point, a **Calibration** may be merited and necessary!

To Stop the Level 4 Span Event (225 ppb) Event and Start the Level 0 (0 ppb) Event:

- To end the Level 4 Event Hit the **Abort** key to stop the process

Note: the STOP key will only Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Particulate Filter Ozone Conditioning Zero Point Procedure (Record in **Routine filter tab** of elog workbook).

Begin by running a ZERO test (0 ppb)

- in Envidas VIEWER, select [**Operational]**.
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select **ZERO**
- Set duration to "01:00:00".
- Hit Start (phase will show countdown and start at top of minute)

- View progress of burn in Viewer >> Dynamic >> Charts >> Ozone

When the Zero Point Ozone Readings Meet the Acceptance Criteria, enter 5 x 1` minute concentrations into the elog workbook.

The ozone logbook will calculate the average for the values entered and compare the average values to the Acceptance Criteria. The Operator and the Logbook will evaluate the Filter Conditioning Data acceptability. The Filter Conditioning Acceptance Criteria are:

iPS (calibrator)	O3 (monitor)
0 ppb	**0 ppb +/- 2 ppb**
225 ppb	**225 ppb +/- 5 ppb**

If these **acceptance criteria** are **not** satisfied, **it is recommended to discuss with PPB and ECB.**

If the Filter Conditioning PASSES the Acceptance Criteria, the flag/Channel must be reset, "Upped" (brought back on line) to collect and report ambient air ozone concentration data.

"Up"/Enable the 49i Channel(s) Resetting the Maintenance flag

Once all data points have been tested and recorded for Calibration, then the operator will unflag/Up (reset) the channels

- **Go to Viewer Dynamic tabular**
- Right click the channel in the Tabular display
- In the options box, select the **Set Channel Flag**
- Select **Reset Flag** (at the top of the dropdown list)
- The instrument status should now change to "**OK**"
- The other marked channel(s) will follow suit as their respective average times is/are satisfied (i.e. 1 min., 5 min., and etc.)
- The channel(s) is/are now up and the Particulate filter and Conditioning procedure is complete

5.6 On-Site Ozone Monitor Manual Performance Check

An **On-Site Manual Performance Check** is a MANDATORY ozone monitoring system performance evaluation when the ozone monitoring system **FAILS** the Daily Auto-PZS Check and Precision Point Analysis Data Acceptance Criteria more than two consecutive days and when an In-Office check fails performance criteria, (There are of course exceptions to this rule and the cause of the failure would certainly be a determining factor as to the necessity of a Calibration; i.e. computer/software network failures may not merit Calibration). **This critical on-site performance evaluation requires the ozone monitoring system to be taken out of ambient air sampling analysis mode. This performance check must occur even if the ozone Forecast AQI is ≥ 65. If possible, this critical performance check should occur as early in the day as possible to hopefully minimize the ozone monitoring data that will be lost during the middle part of the day when the higher levels of ozone concentrations generally occur. The main goal of this performance evaluation is to correct a performance problem that was identified during the Daily Auto-PZS Check and re-establish the high level of data**

confidence required for the ozone data to be reported. If possible, it is also recommended that the 12 Minute Rule be followed to minimize potential lost hours of ozone data.

The Site Documentation and Inspection page of the Ozone Logbook must be thoroughly completed as part of the site visit to perform the On-Site Manual Performance Check. The On-Site Manual Performance Check Worksheet from the ozone logbook is included on page 80-81 of this document.

Log In to Site Computer

- Log in to site computer with personal EADS Username and personal EADS Password (as necessary),
- Log into Envidas **Viewer** and enter the Username and Password (operators personal Envidas)
- Right click on the pollutant you will be working with, i.e. O3 and Set channel flag in the Drop down menu to "**Maintain**", (Note: we use **Maintain** rather than **Calibrate** due to the fact that when we use **Calibrate** it can negatively impact the next day's auto PZS check---this is a software issue!).
- Specify duration (recommended at least 1 hour depending on site visit type),
- Enter **Force Now** to activate.
- Open elog workbook
- Document all relevant information on Documentation Tab including time(s), temperatures, type of visit, and etc.
- Proceed to relevant site visit type Tab (i.e. **On-Site Ozone Manual Performance Check**)

Comment: If this manual performance check is for any other purpose than a Season Opening, or malfunctioning equipment replacement, then some investigative work should be performed prior to performing the Manual Performance check. This could include visual inspection, leak check, etc. A filter change and Leak check should Always precede a Calibration.

Start the SPAN Level 4 (225 ppb) Manual Performance Check Point

- Begin by running a **SPAN** test (225 ppb)
- In Envidas VIEWER, select [**Operational**]

- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select **SPAN**
- Set duration to "**01:00:00**".
- Hit **Start** (phase will show countdown and start at top of minute)

- View progress of the span stabilizing in Viewer >> Dynamic >> Charts>> Ozone

The Level 4 Span Event (225 ppb Ozone) will start and run until stability is observed.

When the Ozone Readings Stabilize Record 5 x 1-minute average ozone concentrations in the On-Site Manual Performance Check section of the Ozone Logbook.

To Stop the Level 4 **SPAN Event and Start the SPAN 2** Level 2 **(65 ppb) Event:**

To end the Level 4 Event (225 ppb) Hit the **Abort** key to stop the process

Note: the **STOP** key will only Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Start The SPAN 2, Level 2 (65 ppb) Span Event.

- Begin by running a **SPAN 2** test (65 ppb)
- In Envidas **VIEWER**, select [**Operational**]
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select **SPAN 2**
- Set duration to "**01:00:00**".
- Hit **Start** (phase will show countdown and start at top of minute)

- View progress in **Viewer >> Dynamic >> Charts >> Ozone**

The Level 2 Span Event (65 ppb Ozone) will start.

When the Level 2 Event Ozone Readings Stabilize, Record 5 x 1-minute average ozone concentrations in the On-Site Manual Performance Check section of the Ozone Logbook.

To Stop the Level 2 (65 ppb) Event and Start the Zero Span Event:

To end the Level 2 Event (65 ppb) Hit the **Abort** key to stop the process

Note: the **STOP** key will **only Pause** the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Section 5.6.1 On-Site Manual Performance Check Zero Event Procedure

Run a **ZERO** test (0 ppb)

- In Envidas VIEWER, select [**Operational**].
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select ZERO
- Set duration to "01:00:00".
- Hit Start (phase will show countdown and start at top of minute)

- View progress of the zero stabilizing in Viewer >> Dynamic >> Charts >> Ozone

The Zero Span Event (0 ppb Ozone) will start and should stabilize for at least 10 minutes (some equipment may require additional time and Operator patience to stabilize)

When the Zero Event Ozone Readings Stabilize, Record 5 x 1-minute average ozone concentrations in the On-Site Manual Performance Check section of the Ozone Logbook.

To end the **Zero Event** (0 ppb) Hit the **Abort** key to stop the process

Note: the **STOP** key will **only Pause** the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

The logbook will calculate the average for the values entered. The Operator and the Logbook will evaluate the average values with the Acceptance Criteria. The Acceptance Criteria are:

iPS (calibrator)	O3 (monitor)
0 ppb ≤ +/- 2 ppb	***i*PS ≤ +/- 2 ppb**
65 ppb ≤ +/- 2 ppb	***i*PS ≤ +/- 3 ppb**
225 ppb ≤ +/- 2 ppb	***i*PS ≤ +/- 5 ppb**

The following On-Site Manual Performance Check Evaluations are performed by the Operator and recorded in the Ozone Logbook:

(1) Transfer Standard (49i-PS) Performance Evaluation

PASSES Acceptance Criteria. No additional action required

FAILS Acceptance Criteria. Contact PPB and ECB

The operator must contact the ECB and PPB. The operator must also review the performance of the ozone monitor. Under **no** circumstance should any adjustments to the ozone monitor be performed using the Transfer Standard that has failed acceptance criteria.

(2) Ozone Monitor (49i) Performance Evaluation

PASSES Acceptance Criteria. No additional action required

The operator should review when the particulate filter was last changed and conditioned. If the AQI forecast is < 65 and a new filter was installed and conditioned greater than 2 weeks before this check was performed and the operator's schedule and task allows the time to do so, it is recommended that the operator perform a filter change and conditioning at the end of a passed On-Site Manual Performance Check and thus reduce the necessity of additional trips to the site.

FAILS Acceptance Criteria. Contact PPB and ECB to get instructions on how to investigate the failure and potentially resolve it during the site visit.

The operator must notify PPB and ECB. **The Ozone Monitor must be Calibrated if and only if the onsite Transfer Standard has PASSED Data Acceptance Criteria.**

If the on-site **Transfer Standard** has also failed data Acceptance Criteria, a **Full Calibration** must **not** be performed.

If the Failure of the Ozone Monitor to Pass the Data Acceptance Criteria is believed to be due the simultaneous failure of the onsite Transfer Standard, the ozone monitor should be brought back on-line and continue to sample and analyze ambient air until the Failure of the Transfer Standard is Resolved. If the failure of the monitor is later determined to be independent of the Transfer Standard Failure, the ozone data collected during this period will be invalidated.

NOTE: If the on-site Transfer Standard FAILS Acceptance, then a new Transfer Standard Unit will be brought to the ozone monitoring site. When the New Transfer Standard Unit arrives, the operator should:

- **Perform an On-site Manual Performance Check of the monitor. If these items pass the Acceptance criteria, then proceed with normal site activities (i.e. filter,**

maintenance, etc.) and follow up with an on-site calibration with multi-point verification to assure that the new transfer standard and monitoring equipment are working properly as a system and are validated to the new transfer standard.

- Then **Perform a Particulate Filter Change, leak check, and Conditioning** immediately prior to performing the calibration.

Refer to **page 15** if a **Calibration and Multi-Point Verification is required!**

If the On-site Manual Performance check proves successful, then reset (up the channels) by the following procedure:

Section 5.6.2 "Up" (unflag/reset) the 49i Channel(s)

Once all data points have been tested and recorded for the On-Site Manual Performance Check, then the operator will unflag/Up the channels

- **Go to Viewer Dynamic tabular**
- Right click the channel in the Tabular display
- In the options box, select the **Set Channel Flag**
- Select **Reset Flag** (at the top of the dropdown list)
- The instrument status should now change to "**OK**"
- The other marked channel(s) will follow suit as their respective average times is/are satisfied (i.e. 1 min., 5 min., and etc.)
- The channel(s) is/are now up and the On-site Manual Performance Check procedure is complete

5.7 Office Actuated Manual Performance Check

An **Office Actuated Manual Performance Check** can be a powerful tool to investigate and validate the performance of an ozone monitoring system. This procedure requires logging into the site computer from the office. This tool can provide additional information when a monitoring system evaluation report shows the system to be operating properly but additional data shows the system is not operating properly. One prime example is the results from the Daily Auto-Precision/Zero/Span (PZS) Check on Saturday morning during an electrical storm FAIL Data Acceptance Criteria but the data from the Daily Auto-PZS Checks on Sunday and Monday mornings PASS the Data Acceptance Criteria. A passing Office Actuated Manual Performance Check does not eliminate the necessity to continue to review this monitoring system to a higher degree than normal but it does reduce the urgency to immediately change work plans and visit the ozone monitoring site to investigate the performance of the ozone monitoring system when available performance data shows the system to be operating properly. **If the ozone monitoring system FAILS the Office Actuated Manual Performance Check, it is MANDATORY that an On-Site Manual Performance Check be performed immediately.**

An important aspect of the Office Actuated Manual Performance Check is the documentation of this check in the Ozone Logbook. It is not possible to remotely provide all the documentation required during all other sites activities on the Documentation worksheet. It is required in the

Office Actuated Manual Performance Check Worksheet that a detailed explanation is provided as to the purpose for performing this check. A significant amount of the Documentation information can be acquired remotely via IPort and taking control of the monitor and calibrator face plate(s).

This remote performance evaluation tool requires the ozone monitoring system to be taken out of ambient air sampling analysis mode. Prior to performing this check the operator is required to review the Air Quality Forecast and the Air Quality Index of the Forecast (AQI). If the air quality forecast is yellow with AQI>65, then this performance check should be delayed if possible because additional information is available which shows the ozone system to be operating within data acceptance criteria. This performance check should occur as early in the day as possible to hopefully minimize the ozone monitoring data that will be lost. If possible, it is also recommended that the 12 Minute Rule be followed to minimize potential lost hours of ozone data.

Section 5.7.1 Remote into the Site Computer(s) via the Regional Office Computer or VPN

- Open Windows
- Go to Remote Desktop Connection
- Enter IP address for site modem
- (A complete list is available on the **"P" Drive under Ambient >> ECB >>Site Wireless Information >>** use most current dated file and Address will start with **10.251.197.xxx**)
- Enter site IP address and hit Enter and then Connect
- Enter your credentials and
- Select **Use Another Account**
- Use **EADS** Log in information and **EADS** Password
- Hit 'OK'
- Note: if a Warning Box appears, answer YES
- A State of NC Box will appear and hit the OK button

You are now online with the site computer remotely

- Log into Envidas Viewer and enter your Username and Password (operators personal)
- Right click on the pollutant you will be observing (i.e. O3)
- Set Channel Flag in the dropdown menu and pick "**Maintain**"
- Specify a time duration (recommended **<u>at least 1 hour</u>** depending on estimated on-line activities
- Enter **Force Now** to activate
- Open your elog workbook and fill in as much information as obtainable from remote site

Note: at a minimum you will need **Documentation Page** and Remote- **Office Actuated Manual Performance check Page(s)** to be recorded with explanation for Off-Site (Remote) check and rationale for doing an office-actuated manual performance check (i.e. Bad Precision/Zero/Span checks, etc.)

- Proceed to relevant site visit type (i.e. Remote-**Office Actuated Manual Performance Check**)

Section 5.7.2 Start the Level 4 (225 ppb) Performance Check Point.

Begin by running a SPAN test (225 ppb)

- In Envidas **VIEWER**, select [**Operational**]
- Select [**Phase from Sequence**]
- Select **O3MAN**
- Select **SPAN**
- Set Duration to **"01:00:00**" (1 hour)
- Hit **Start** (phase will display countdown and start at top of the next minute)
- You can view the progress of Level 4 in ***Viewer >> Dynamic >> Charts >> Ozone***

The Level 4 Span Event (225 ppb Ozone) will start and run until stability is observed (usually 10 min. or less)

When the Ozone Readings Stabilize, Record 5 x 1-minute average ozone concentrations in the Remote-<u>Office Actuated Manual Performance Check</u> section of the Ozone Logbook.

To Stop the Level 4 Event and Start the Level 0 Event:

- Hit the **Abort** key to Stop the process (level 4)

Note: The **STOP** key will <u>only</u> Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to 1 hour run time by default); Hence <u>use</u> the **Abort** key to Stop!

- Run a **ZERO** test (O ppb)
- In Envidas **VIEWER**, select [Operational]
- Select [Phase from Sequence]
- Select **O3MAN**
- Select **ZERO**
- Set duration to "01:00:00" (1 hour)
- Hit START (the ZERO phase will display countdown and start at the top of the next minute)
- View progress of ZERO phase in ***Viewer >> Dynamic >> Charts >> Ozone***

The Zero Span Event (0 ppb Ozone) will start and run until stability is observed (usually 10 min. or less)

When the Zero Event Ozone Readings Stabilize, Record 5 x 1-minute average ozone concentrations in the Remote-Office Actuated Manual Performance Check section of the Ozone Logbook.

Hit the **Abort** key to stop the process.

The logbook will calculate the average for the values entered. The Operator should double check the values to confirm.

The Logbook will evaluate the average values with the Acceptance Criteria. The Acceptance Criteria are:

iPS (calibrator)	O3 (monitor)
0 ppb ≤ +/- 2 ppb	***i*PS ≤ +/- 2 ppb**
225 ppb ≤ +/- 2 ppb	***i*PS ≤ +/- 5 ppb**

The following **Office Actuated Manual Performance** Check Evaluations are performed by the Operator and recorded in the Ozone Logbook:

(1) Transfer Standard (49i-PS) Performance Evaluation

PASSES Acceptance Criteria. No additional action required

FAILS Acceptance Criteria. Contact PPB and ECB

The operator must contact the ECB and PPB. The operator must perform an On-site Manual Performance Check.

(2) Ozone Monitor (49i) Performance Evaluation

PASSES Acceptance Criteria. No additional action required

FAILS Acceptance Criteria. A Site Visit is Required

The operator must perform an On-Site Manual Performance Check

Section 5.7.3 "Up" the 49i Channel(s): (reset Flag)

Once all data points have been tested and recorded for the Office Actuated Manual Performance Check, then the operator will reset the flag/Up the channels

- **Go to Viewer Dynamic tabular**
- Right click the channel in the Tabular display
- In the options box, select the **Set Channel Flag**
- Select **Reset Flag** (at the top of the dropdown list)
- The instrument status should now change to "**OK**"
- The other marked channel(s) will follow suit as their respective average times is/are satisfied (i.e. 1 min., 5 min., and etc.)
- The channel(s) is/are now up and the **Office Actuated Manual Performance check** procedure is complete
- Document the Check in the elog workbook with as much information as possible to explain the rationale of the Office check
- **Close** any open programs (i.e. Viewer, Reporter, etc.)
- **Sign Out** by Starting Windows menu by **Right clicking on the 'body shaped' icon,** select **Sign out,** and this will take you back to the computer monitor screen.

6.0 OZONE LOGBOOK SUBMITTAL and DATA RETRIEVAL

The Ozone Logbook serves as the primary Record and Document for evaluating the Success/Failure of the operation of the ozone monitoring site and is the essential record for determining the quality of the ozone data reported from each site.

1. The **Site Operator** must complete the Ozone Logbook to document the purpose of **Every** site visit, the observations and findings during the site visit, and the evaluation of the performance of the ozone monitoring system for each site visit. This includes any and **all** startups and shutdowns (including severe weather events, power loss, temperature extremes, and etc.). Undocumented site activities can result in loss and/or invalidation of significant amounts of valuable data and the upmost effort should be exercised in not only documenting all activities but supplementing with adequate comments that make the activity clear and concise to any reader.
2. The Site Operator must submit the ozone logbook to the Regional Ambient Monitoring Coordinator or Designee for review and comment as soon as reasonably possible after the site visit and at a minimum by the end of each month. Additionally, a Site log **Documentation page** should be annotated with **any/every** site visit; i.e. shutting down for approaching weather, final calibrations for close out of season, season start-ups and shut downs, and etc. **All site visits** merit, at a minimum, the input and comments on the Documentation page. (If it is not documented, then we cannot conclude nor prove that anything happened!).
3. The **Regional Ambient Monitoring Coordinator** or Designee must review site operator monthly submitted ozone logbooks for each region and evaluate each logbook for completeness and operator adherence to operating procedures. The regional ambient monitoring coordinator must also consider and compare all ozone logbooks submitted for all ozone sites in the region and determine if a pattern of operation is negatively impacting the ozone sites in that region. Following that review the Regional Ambient Monitoring Coordinator **must** Initial and submit each ozone logbook to the Projects and Procedures Branch Chemist for review.
4. The **Projects and Procedures Branch Chemist** must review the logbooks submitted by each region from all ozone sites for completeness and adherence to operating procedures. The Projects and Procedures Branch Chemist must also review the logbook submitted from each region and from all regions to determine if there is a procedures or pattern of operation that may be negatively impacting the overall operation of the ozone monitoring network and the quality of the ozone data reported.

6.1 Data Review

Each business day, the RCO statistician initiates a data review by providing a raw data report (in a spreadsheet format) to each Regional Office. (Reference Section III: Regional Office Polling and Data Review and Section IV: Data Review & Validation QA Plan for Continuous Gaseous & Non-Speciated Particulate Monitors) The RCO may request the Regional Office to send additional data that are needed beyond what the RCO requires for verifying any missing data supplied by the Regional Office. These data can be retrieved from the "site monitor" as needed. (Refer to RCO

Guidance Documents under the Documents section on NC DAQ's Ambient Monitoring SharePoint page for instructions.

7.0 FILE MANAGEMENT (Opening, Naming & Storing, Data Handling)

Site operators and technicians must maintain a site computer or lap top PC to generate the electronic site logbook (e-log) files from a Microsoft Excel file. The e-logs are provided from Raleigh Central Office PPB chemists and are updated periodically to reflect EPA updates, requirements, and guidance. The e-logs will comply with NCDAQ QAPP's and SOP's accordingly and must be completed and signed by Site Operators as well as Regional Ambient Monitoring Coordinators. The file naming protocol is provided below. *A formalized naming convention has been established through consensus of the regions and the RCO and should be used consistently by all regions.*

7.1 Opening, Naming, and Storing of the Site Files

The e-log template file used at the site should be stored on the PC used for field operations by the site operator or field technician; see ***Section 13.0*** of this SOP for an example of the e-log. E-logs can also be found in DAQ's Internet-Based Enterprise Application Management system (IBEAM). To access the file, open the e-log template file using Excel. Every time a new e-log is completed using the template it must be renamed and saved as a separate and complete logbook (all sheets, i.e., tabs, saved) to preserve the record. Do NOT copy over a previously completed e-log. *Refer to the Logbook file naming convention "Policy Memorandum" dated January 1, 2011 located in the DAQ IBEAM module (summarized below)*

- Open the appropriate Logbook e-log template file using Excel
- Left click the "file" toolbar icon, scroll down to "save as" and left click. Every time a new e-log is filled out using the template, it must be renamed and saved as a separate and complete workbook (all sheets, i.e., tabs saved) to preserve the record. ***Do not copy over previously completed e-logs.***
- Under file name (highlighted) change the Logbook file name using the following format: Site ID O3 Date Activity code. For example, "**MQ O3 20190601 BA**.xls" is a site visit 'Maintenance/routine repairs (most commonly activities are: **BA**-Maintenance, **BF**-Precision/Zero/Span, **BC**-Calibration, and **SV**-Site Visit)
- Change save location to operator's choice of folders
- Left click "save"
- Find the tab needed for the task involved. The first tab selected should be the Logbook Documentation worksheet. Fill in all information as indicated.
- Open other tabs as needed and fill in information as indicated.
    - Save the Logbook (e-log) periodically and when finished entering data

8.0 QUALITY ASSURANCE & DATA REPORTING AND VALIDATION BY REGIONAL OFFICE

Each month the Regional Operator and Ambient Monitoring Coordinator are required to Review and Validate the Hourly Ozone Concentration Data and the Precision Point Analysis Reports for each site. These electronic reports are provided by Envista software and reviewed by the Projects and Procedures Branch (PPB) Statistician. The review and validation are performed in the office based upon the results and documentation provided in the ozone logbook and supplemental Envista data retrieval as well. The most commonly utilized Standard EPA Qualifier and null codes are provided below. (Also, Refer to **RCO Guidance Documents** under the Documents section on NC DAQ's Ambient Monitoring ***SharePoint*** page for more detailed instructions.

Frequently Used Ozone Data Invalidation Codes		
CODE	**AQS Description**	**Condition (when to Use)**
AC	Construction/Repairs in Area	Bldg. demolition, road construction, etc.
AD	Shelter Storm damage	Hurricane, high winds, rain, lightning, flood
AE	Shelter Temperature outside limits	Shelter Temperature Outside 5ºC---40º C
AJ	Filter Damage	Water in Filter/sample line
AK	Filter Leak	Filter and/or sample line leak (obs. Site visit)
AN	Machine or Equipment Malfunction	Equipment, component, etc. failure
AO	Bad Weather	Severe weather impacting monitoring
AS	Poor Quality Assurance Results	Bad/invalid site data check (bad PZS, etc.)
AV	Power Failure	Power Failure and/or 'spike'
AY	QC Control Points (zero/span)	Office actuated Manual Performance check
AZ	QC Audit (ECB performed)	ECB Performance Audit
BA	Maintenance/Routine Repairs	Routine Maintenance and repairs
BB	Unable to Reach site	Due to storm, construction, etc.
BC	Multi-Point Calibration	Calibration with multi-point verification
BD	On-site Manual Performance check	On-site Manual Performance check
BF	Daily Auto-Calibration Precision check	Daily Automatic Precision/Zero/Span check
BJ	Operator Error	Op. error, i.e. Operator fails to return to sample mode
BK	Site Computer/logger down	Prefer to use **BK** for **known computer** or **DAS problems**
BN	NPAP Audit (EPA)	EPA Site Performance Audit
SA	Storm Approaching	Storm/Bad Weather approaching
QV	Quality Control Multi-point verification	Multi-Point Verification (check)

The **Review of the Monthly Ozone Hourly Concentration Data and the Precision Point Analysis Reports** at the Regional Office is a critical step that insures the highest quality data

possible is reported from each ozone monitoring site. This Review and Validation includes but is not limited to the following:

1. The **Operator** (site technician) must investigate, correct as necessary, and detail the cause for all missing ozone hourly concentration data and any and all corrections proposed to the existing data reports. The **Operator** must also investigate, correct as necessary, and detail the cause for missing, and/or corrections made to the Precision Point Analysis Results Report including Precision Analysis Reported Results that do not meet Data Acceptance Criteria. Assistance shall be provided as requested by the Regional Ambient Monitoring Coordinator, the Projects and Procedures Branch Chemist and Statistician, the Electronics and Calibration Branch Senior Electronics Specialist. Thorough Documentation is essential for all activities.

2. The **Operator** (site technician) shall provide an explanation for **all** invalidated Ozone Data and Invalidated Precision Point Analysis Results. An **AM** (Miscellaneous Void) invalidation code will **no** longer be accepted by EPA as an Invalidation code. The Invalidation code must represent more compelling clarity of what the relevant issue was that occurred to necessarily invalidate any suspect data. The Envista software will code the relevant Operator that has reviewed and edited the data following his/her review and submittal. In most cases, the Data Invalidation Code(s) will provide enough information but that is not true for all cases. In some instances, the site Operator will notify the Regional Ambient Monitoring Coordinators and/or PPB chemists with more detailed explanations of anomalies or errors. The Operator then submits these Reviewed reports to the Regional Ambient Monitoring Coordinators for Review and Approval.

3. The **Regional Ambient Monitoring Coordinator** must investigate any and all loss of hourly ozone data and missing or failed Precision Point Analysis Results. The **Regional Ambient Monitoring Coordinator** must provide any further explanation or clarification as they deem necessary to detail the cause for any lost ozone data from each ozone monitoring site in the respective region. The **Regional Ambient Monitoring Coordinator is also charged** with evaluation of data from each ozone site operated in the region and determining if a similar pattern of missing data and/failures is occurring. Each observed pattern must be investigated further by the Regional Ambient Monitoring Coordinator. Assistance shall be provided as requested by the Regional Operator and Ambient Monitoring Coordinator, the Projects and Procedures Branch Chemist and Statistician.

4. The **Regional Ambient Monitoring Coordinator** submits the **Initialed and Dated** reviewed reports to Envista (Level 2) and subsequently the Projects and Procedures Branch Chemists will review (Final Review) for Approval.

5. The **Projects and Procedures Branch Chemist** must investigate any and all loss of hourly ozone data and missing or failed Precision Point Analysis Results. The **Projects and Procedures Branch Chemist** must provide any further explanation or clarification as they deem necessary to detail the cause for any and all lost ozone data for each ozone monitoring site. The Projects and Procedures Branch Chemist is also charged with the evaluation of the ozone data reports from the entire Ozone Monitoring Network. The Projects and Procedures Branch Chemist must evaluate the data from all monitors to

determine if similar patterns in Lost Data, Invalidated Data, and data failing to meet Data Acceptance Criteria exist. Assistance **must** be provided as requested by the Regional Ambient Monitoring Coordinator, the Regional Chemist and Statistician, and the Electronics and Calibration Branch Senior Electronics Specialist.

6. The **Projects and Procedures Branch Chemist** submits the Reviewed Monthly Ozone Concentration Data and Precision Point Analysis Reports **Level 3** final approval to the Management and Statistical Analysis Branch. These Reviewed and Approved Reports serve as the basis and required documentation to make changes to the existing ozone hourly concentration reports and Precision Point Analysis Reports that are provided as required to the EPA and submitted to AQS.

A summary Table of the Ozone Monitoring System Performance Acceptance Criteria is included on Page 68---**Site Activities**.

9.0 TROUBLESHOOTING AND CORRECTIVE ACTIONS

The table below provides some common problems observed with Ozone monitoring equipment and checks that the operators should attempt before requesting additional assistance. If the operator is not comfortable with **any** of these issues, then please contact ECB or PPB before attempting.

Potential Problem	Potential Symptom	Action or Correction
Negative O3 Values	Possible stuck solenoid during PZS checks	Try running remotely, then on-site, then if all else fails contact ECB
Negative O3 Vales	Loose connection on circuit board to calibrator	Check leads and connections (wiggle test)
Negative O3 Values	Possible bad Ozonator lamp—check A/B intensities	If checked twice and still bad, contact ECB
Negative or erratic O3 values	Water in sample line or clogged probe port	Dry line, replace and condition filter, Z/S check
Excessively High O3 Values	Solenoid stuck/not switching; moisture in drain	Dry line, replace and condition filter, Z/S check
Not reaching high point in PZS checks	Bad Ozonator	Test Zero and Span points and if still bad call ECB
High value stuck, low value leaking down	Intra-line leak---perform leak test to check	If leak test fails, check all connections and call ECB
Autocal drifting, monitor following calibrator	Bad Calibrator	Run P/Z/S and allow time for points to stabilize, if still bad try Calibration with Verification
Drifting Values	Leak(s), noise, Bad Ozonator lamp	Run leak test and Run lamp intensity test
Data Loss	Comm. Port disconnected, power surge, breaker trip	Check all electrical connections, plugs, UPS, and confirm channels are reset
Unusually Low O3 Values	Moisture in Lines/filter	Dry line(s), replace and condition filter, run P/Z/S
Lack of variation in daily O3 monitoring data	Operator error---forgot to plug sample line in after routine maintenance	Run remote Z/S first and follow up at site visit if necessary and check connections
Cannot achieve Acceptance limits on site maintenance checks	Need to allow more time to burn in filter after changing/replacing	Rerun PZS points and allow adequate time to stabilize

Potential Problem	Potential Symptom	Action or Correction
'AI' flag in data	Check minute data for power surge and correct/label	Check and edit with appropriate Code if necessary and save/validate
Continuous 'BA' code displayed from site	Operator forgot to reset (up) the channel when finished with site visit/maintenance	Reset the channels per SOP instructions
Moisture in probe line/filter housing	A/C diffusers aimed at line, heat tape not working, site temp. not set properly, ck. Sample line also	Correct as appropriate at site visit and Document in elog workbook
Too long residence time (>20 sec)	Leak in system	Leak test, replace filter, test again and check all lines and connections; Run P/Z/S as appropriate
Incorrect flow (<1 lpm or >3 lpm)	Check all lines for leaks	If no leak discovered, contact ECB
Incorrect cell flow balance (<+/- 0.1 lpm)	Stuck solenoid or leak in system	Try to run P/Z/S, if no success follow up with ECB
Lamp intensity (<45 kHz or >175kHz) or >20kHz difference in Cell A and Cell B	Dirty mirror(s), dirty cell, debris stuck in a tube, call ECB on this one	Contact ECB for specific instructions
Ozone Background Factor bad (<-3 or >+3)	Check for leaks and loose connections and Retest Factor check	If bad after second check, contact ECB
Ozone Coefficient Cal Factor bad (<0.95) (Normal 0.95 – 1.05)	Rerun Cal check a second time	If bad after checks, contact ECB
Ozone Coefficient Cal Factor bad (>1.05)	Leak suspected; ck. Lines, filter, solenoids, connections	Rerun Factor test and if bad after second check, contact ECB
Pressure on ZAP not to spec (20-30 psi)	Bad pump, filter, leak, clogged drain line	If no leaks and line cleared, contact ECB
UPS backup battery displaying <50% charge	Replace battery	If no good after new battery, contact ECB

10.0 REVISION HISTORY

1. Updated Revision Number and SOP formatting, adding additional Sections
2. Modified the individuals required to review and sign
3. Revised and defined calibration frequency schedule
4. Added multi-point verification procedure to include ZERO and 4 upscale points per 40 CFR Part 50, Appendix C, Section 4.
5. Change duration of system operations interrupted from 48 to 72 hours
6. Removed references to AirVision
7. Updated procedures to include use of Envidas Data Acquisition System
8. Added information about Comet Temperature Probe
9. Added procedures for HoBo launch and data downloads
10. Added Section 9.0 and 11.0
11. Glossary of Terms (*Appendix F*) included
12. Guidance for Useful Logbook Documentation (*Appendix G*) included
13. Addition of Reference materials
14. Addition of Glossary terms and redefined checks
15. Addition of Zero and Span reported to AQS/EPA (*Sect. 5.2*)

11.0 REFERENCES

1. EPA CFR 40 Parts 50 and 58, including all Appendices
2. QA Handbook for air Pollution Measurement Systems: “Volume I: A Field Guide to Environmental Quality Assurance”, EPA-600/R-94/038a, April 1994
3. QA Handbook for Air Pollution Measurement Systems: "Volume II: Ambient Air Quality Monitoring Program" EPA-454/B-17-001, January 2017
4. Regional Office Polling and Data Review SOP 2.8.3
5. Data Review & Validation QA Plan for Continuous Gaseous & Non-Speciated Particulate Monitors SOP 2.41.4
6. US EPA Ambient Monitoring Technology Information Center (AMTIC), Quality Assurance Guidance Documents; Validation Templates, Data Certification, Calibrations. epa.gov/amtic/amtic-quality-assurance
7. Quality Assurance Project Plan (QAPP) for the North Carolina Division of Air Quality Ozone Ambient Air Quality Monitoring Program; July 2019.

12.0 APPENDICES

APPENDIX A: Time(s) Recording Procedures

Download and Launch/ReLaunch Hobo computer time (required 1/month)

You will now record not only the DAS (i.e. Envidas) time reflected on the computer monitor, but also record Analyzer time (from the 49i face) and HOBO time. You will also check and record NIST time. This can be acquired from ***https://time.gov***. This is very important since we no longer have the data logger to compare to and NIST should be primary and DAS should be in agreement with NIST. The Analyzer,49i, should be in agreement with DAS. If not, contact ECB! Additionally, you should check and record the HOBO time when the HOBO is relaunched at your monthly visit. We are also mandating that you download the HOBO temperature data and save in a secured site/share since this is/will be the back-up temperature data for the site in the event of an Envidas/Envista/computer failure. Hence, you must record all **4 times**; ***DAS*, *Analyzer*, *HOBO*, and *NIST*. (Note:** The HOBO time will merely be a reflection of the time you Launched the HOBO data following the required monthly data recovery and storage.).

APPENDIX B: Reference Guidelines for Envista/Envidas procedures

Multiple Envista Procedural Guidelines have been added to the SOP's for 2018/2019/2020. Due to the dynamic nature of the software updates, the documents have been referenced and placed into the ***SharePoint*** data share located at the following address:

NCDAQ Ambient Monitoring >>Documents>>EnVista-EnviDas>>RCO Guidance Documents

The Guidelines include but are not limited to the following Documents:

1. **Displaying Real Time Graph and Minute Data**
2. **Exporting Data from HOBO Temperature Data Logger**
3. **Importing Data using Envista**
4. **Marking Data Channels Down/Up**
5. **Remote Desktop User Instructions**
6. **Probe/line drying Procedures for Thermo 49i Ozone Monitor**
7. **Nafion™ filter assembly and leak check procedure** (optional at some sites)

APPENDIX C: Particulate Filter Change and Conditioning Procedure

1. Log in to site computer with Personal EADS ID and your Personal Password (as necessary),

2. Log into Envidas **Viewer** and enter your Envidas Username and Envidas Password (operators personal)

3. Right click on the pollutant you will be working with, i.e. O3 and Set channel flag in the Drop down menu to "**Maintain**",

4. Specify duration (recommended at least 1 hour depending on site visit type)

5. Enter **Force Now** to activate.

6. Open elog workbook

7. Document **all** relevant information on **Documentation Tab** including time(s), temperatures, type of visit, and, etc.

8. Proceed to relevant site visit type **worksheet** Tab (i.e. **Routine filter**)
9. **Check and Record the Computer Time(s) and Temperature(s)**
10**. Pre-Leak test**
Note: It is **Now Required** to Perform a **Pre-leak test** before changing the filter (this often helps uncover potential issues early on, especially if anomalies have been sporadically occurring at a site.). This process could also help bracket and save suspect data.

- Press the **Menu Button** on the front of the 49i Monitor
- Go to Diagnostics Menu and Select the **Pressure Screen**
- Disconnect the Ambient input line from the sampler input port and plug the line with a plastic plug
- The pressure should decrease below 250 mm Hg within a **minute** or less.
- If the pressure does not drop there is already an existing leak in the system and this should be noted in the elog workbook and this could affect data review and **data bracketing**
- Proceed with the Filter Change as follows

Filter Change Procedure

- Disassemble the filter holder with the filter disassembly wrenches provided.
- Remove the existing filter and inspect the filter support screen.
- If the filter support screen is dirty rinse with de-ionized water and then dry.
- Reinstall the filter support screen.
- Touching only the outer edge of the new filter place the filter in the holder.

- Reassemble the filter holder. DO NOT OVER TIGHTEN THE FILTER HOLDER FOR THIS CAN TEAR THE FILTER AND/OR DAMAGE THE FILTER HOLDER.

Perform a Post Leak Test on the 49i

- Press the Menu Button on the front of the TEI 49i Ozone Monitor
- On the "Diagnostics Menu" Select **Pressure Screen**
- Disconnect the Ambient input line from the back of the particulate filter holder and plug the opening with a plastic plug.
- The pressure should decrease below 250 mm Hg within 1 minute or less.
- If pressure does not drop there is a leak. Remove Ambient Inlet plug fitting and check all fittings and check the input lines for cracks and correct as necessary
- Repeat leak test. If fails. Contact ECB for assistance in correcting leaks.
- If leak corrected and test is passed reattach the ambient input line to the sample input port.
- Press Run and continue with filter conditioning.

Particulate Filter Ozone Conditioning Procedure Level 4 (225 ppb) Event

- Begin by running a **SPAN** test (225 ppb)
- **in Envidas VIEWER, select [**Operational**]**
- Select [**Phase from Sequence**]
- Select **[O3MAN]**
- Select **SPAN**
- Set duration to "**01:00:00**"
- Hit **Start** (phase will show countdown and start at top of minute)
- View progress of filter burn-in **Viewer** >> **Dynamic** >> **Charts**>> **Ozone**

The Level 4 Span Event (225 ppb Ozone) will start and should run for at least **10** minutes to condition the particulate filter. (It may take longer to stabilize.)

When the Ozone Readings Meet the Acceptance Criteria (225 ppb +/- 5 ppb) and are Stable then record 5 x 1-minute average ozone concentrations in the elog workbook on the **Routine Filter tab**.

Note: If the readings do **not** stabilize at a level that meets the acceptance criteria, replace the Filter, leak check, and repeat. If second filter conditioning does not stabilize contact the ECB or PPB. At this point, a **Calibration** may be merited and necessary!

To Stop the Level 4 Span Event (225 ppb) Event and Start the Level 0 (0 ppb) Event:

To end the Level 4 Event Hit the **Abort** key to stop the process

Note: the STOP key will only Pause the operation and would try to continue to run until that sequence was timed out (all have been preset to **1 hour** run time by default).

Particulate Filter Ozone Conditioning Zero Point Procedure

(Record in Routine filter tab of the elog workbook).

Begin by running a ZERO test (0 ppb)

- in Envidas VIEWER, select [**Operational**].
- Select [**Phase from Sequence**].
- Select **[O3MAN]**.
- Select **ZERO**
- Set duration to "01:00:00".
- Hit Start (phase will show countdown and start at top of minute)
- View progress of burn in **Viewer** >> **Dynamic** >> **Charts** >> **Ozone**

When the Zero Point Ozone Readings Meet the Acceptance Criteria enter 5 x 1` minute concentrations into the elog workbook.

The ozone logbook will calculate the average for the values entered and compare the average values to the Acceptance Criteria. The Operator and the Logbook will evaluate the Filter Conditioning Data acceptability. The Filter Conditioning Acceptance Criteria are:

iPS (calibrator)	O3 (monitor)
0 ppb +/-2 ppb	0 ppb +/- 2 ppb (-2 to +2 ppb)
225 ppb	225 ppb +/- 5 ppb (220-230 ppb)

If these **acceptance criteria** are **not** satisfied **it is recommended to discuss with PPB and ECB.**

If the Filter Conditioning PASSES the Acceptance Criteria the flag/Channel must be reset, "Upped" (brought back on line) to collect and report ambient air ozone concentration data.

"Up"/Enable the 49i Channel(s) Resetting the Maintenance flag

Once all data points have been tested and recorded for Calibration, then the operator will unflag/Up (reset) the channels

- **Go to Viewer Dynamic tabular**
- Right click the channel in the Tabular display
- In the options box, select the **Set Channel Flag**
- Select **Reset Flag** (at the top of the dropdown list)
- The instrument status should now change to "**OK**"
- The other marked channel(s) will follow suit as their respective average times is/are satisfied (i.e. 1 min., 5 min., and etc.)

The channel(s) is/are now up and the Particulate filter and Conditioning procedure is complete.

APPENDIX D: Auto Cal Precision/Zero/Span Checks and Activities

Daily Auto-Precision/Zero/Span (P/Z/S) Check and Precision Point Analysis Evaluation

The Daily Ozone Auto-P/Z/S Check is the day-to-day performance metric for the Ozone Monitoring System. The Ozone Monitor is challenged daily with 3 concentrations (0 ppb, 65 ppb, and 225 ppb) of ozone generated by the Ozone Transfer Standard. The Transfer Standard has Acceptance Criteria compared to expected concentration values and the Ozone Monitor values are compared to the Transfer Standard Values.

Site Transfer Standard	Site Ozone Monitor
0 ppb +/- ≤ 2 ppb	Site Transfer (0 ppb) Value +/- ≤ 2 ppb
65 ppb +/- ≤ 2 ppb	Site Transfer (65 ppb) Value +/- ≤ 3 ppb
225 ppb +/- ≤ 2 ppb	Site Transfer (225 ppb) Value +/- ≤ 5 ppb

Daily Auto-Calibration Performance Evaluation and Activity Flow Chart

Ozone System PASSES

Precision Point (65 ppb) Analysis from the Daily Auto-Calibration Check is Reported to the EPA

Activities Throughout the Ozone Season

March 1 thru Oct 31, shutdown Nov

1. Review the Daily Monitor Auto-P/Z/S Check and Temperature report each morning.
2. If the temp. is outside of 5-40° C the site temp. problem must be investigated and corrected to within 5-40° C.
3. At a minimum every 30 Days a Site Inspection and Change and Condition a Particulate Filter

Filter change and conditioning is an important step in protecting the quality ozone data reported and the instrumentation.

Particulate Filter Change and Conditioning Considerations

If the Daily Auto-P/Z/S Check has PASSED Acceptance Criteria and the Particulate filter change is due but the Ozone Forecast is AQI ≥ 65.

- The filter change should be postponed until the AQI forecast is AQI < 65 (60 ppb ozone)
- If the filter change can not be postponed until the forecast is AQI < 65, the filter change and conditioning must occur when the ambient air ozone concentration at the site is < 60 ppb
- IF Filter Change & Conditioning can not be postponed until the AQI forecast is < 65 and the ozone concentration is < 60 ppb Notify the Regional Chemist and the PPB before changing and conditioning the filter in accordance to the 9:12 Rule.
- 9:12 Rule Site activities requiring the ozone monitor to be taken offline and out of the sampling mode whenever possible must be completed by 9:12 am.
- The monitor can be taken offline spanning a time period of 12 minutes before and after the hour without impacting data completeness criteria and creating a False 8-Hr Average
- The Mountain Top Sites are exempt from the 9:12 Rule for daytime activities.

4. Season Ending Daily Auto-Precision/Zero/Span Check November 1st

TRANSFER STANDARD FAILS

Notify the Regional Chemist, ECB, and PPB of the Site Transfer Standard Failure to meet Data Acceptance Criteria

On-Site Monitor Calibration Check is REQUIRED to Evaluate the Site Transfer Standard Performance

Site Inspection and Documentation

Perform On-Site Calibration Check

- PASSES → Transfer Standard Passes On-Site Cal-Check Acceptance Criteria (See Note A. Below) → Return to Daily Auto-Cal Performance Evaluations
- Optional → Particulate Filter Change if Needed and Air Quality Forecast is Yellow AQI <65 and Ozone Conc. is < 60 ppb (See Note A Below) → Return to Daily Auto-Cal Performance Evaluations
- Fails → Transfer Standard FAILS the On-Site Calibration Check Acceptance Criteria
  1. Make No Adjustments to the Ozone Monitor. Return monitor to air sampling mode.
  2. Notify the Regional Chemist, ECB, and PPB that the site Ozone Transfer Standard has Failed the On-Site Calibration Check
  3. Ozone Transfer Standard must be replaced (See Note B Below)

New Ozone Transfer Standard Assigned to Site

Perform a Calibration Check of the Site Ozone Monitor with the new Transfer Standard

- PASSES: Calibrate the Site Ozone Monitor with the new Site Transfer Standard
- FAILS: Make no Adjustments to the Ozone Monitor. Notify Regional Chemist, ECB, and PPB

Return to Daily Auto-Cal Performance Evaluations

Notes

Ozone Transfer Standard PASSES the On-Site Calibration Check

- A
  - 1 No Ambient Ozone Data Invalidated
  - 2 Daily Auto Calibration Check Precision Point is Invalidated
  - 3 IF AQI forecast is < 90 and current ozone < 60ppb; If operator schedule allows

Ozone Transfer Standard FAILS the On-Site Calibration Check

- B
  - 1 Notify PPB, ECB, Regional Chemist of Failure
  - 2 Return the Ozone Monitor to Sampling Mode.
  - 3 If it is later determined the site ozone monitor has also failed the ambient air ozone data collected during this period will be invalidated.

MONITOR FAILS

Notify the Regional Chemist, ECB, and PPB of the Ozone Monitor Failure to meet Data Acceptance Criteria

On-Site Monitor Calibration Check is REQUIRED

Site Inspection and Documentation

Perform On-Site Calibration Check

- Passes → Monitor Passes On-Site Cal-Check Acceptance Criteria (See Note # 1 Below) → Return to Daily Auto-Cal Performance Evaluations
- Optional → Particulate Filter Change if needed and Air Quality Forecast is Yellow AQI <65 and Ozone Conc. is < 60 ppb (See Note # 1 Below) → Return to Daily Auto-Cal Performance Evaluations
- Fails → Monitor FAILS On-Site Calibration Check Acceptance Criteria (See Note # 2 Below)
  - Fails → Ozone Monitor Calibration Required
    - FAILS Calibration Acceptance Criteria
      1. Troubleshoot Ozone Monitor
      2. Notify Regional Chemist, ECB, and PPB
  - Passes → PASSES Calibration Acceptance Criteria: Return ozone monitor to sampling ambient air → Return to Daily Auto-Cal Performance Evaluations

Notes

Monitor PASSES the On-Site Calibration Check

- 1
  - A No Ambient Ozone Data Invalidated
  - B Failed Auto Cal Precision Point Reported
  - C Particulate Filter Change and Conditioning; IF AQI forecast is ≤ 65 and current ozone < 60ppb; If operator schedule allows

Monitor FAILS the On-Site Calibration Check

- 2
  - A Notify PPB, ECB, Regional Chemist of Failure
  - B All Hourly Ozone Data back to the immediately prior Satisfactory Calibration or Auto-Calibration Check or Performance Audit is Invalidated
  - C Failed Auto-Cal Check Precision Point is not Reported
  - D Full Calibration of the Ozone Monitor is Required

APPENDIX E: Quick Guide for Ozone Calibration and Multi-Point Verification

- Site Checks and **Documentation** Sheet filled out (name, date, temps, times, heat tape, bkg. Factor, Cal coeff, lamp intensity, residence time-A/B, flow, UPS cond., ZAP, etc.)

- **Calibration**—ck. Temp and Ozone concentration

- **Pre-leak check** >>> Filter change >>> **Post filter leak check** If good, Proceed; If leaking find leak and repeat filter change and repeat leak check(s)

- **Span** (**225 ppb**) >>> **menu**…**viewer**…**Operational**…select **Phase from Sequence**…**O3MAN**…select **SPAN**…set duration at least **01:00:00**…hit **Start** (view progress in **Viewer** >>>**Dynamic** >>> **Charts** >>> **Ozone**) >>>Allow to stabilize and record the 5 x 1 minute values into the elog workbook >>> leave the Span (225 ppb) and start the Zero event by hitting **Abort**, then

- Start test **Zero** by **Viewer**…**Operational**…select **Phase from Sequence**…select **O3MAN**…select **Zero**…duration **01:00:00**…hit **Start** (view progress in **Viewer**>>**Dynamic**>>**Charts**>>**Ozone**)…allow to condition/stabilize and enter 5 x 1 minute values into the elog workbook (+/- 3 ppb*) and proceed to **Adjustment Phase** of Calibration

- Run Span (225 +/- 5 ppb) >>> Run Zero +/- 3 ppb*) >>> If meets criteria proceed, if not, first allow more time to condition filter and retest point(s)

    - *Note---this is 'relaxed' to **3 ppb** only in the interest of time to proceed with the Calibration, the conditioning may take significantly longer when the **Adjusted Zero** is performed below in the procedures

---

- Start '**Adjustment**' Phase of Calibration (**Zero <u>must</u>** be run **<u>first!</u>**) Allow ample time to condition filter (30-45 minutes) >>> Start Calibration >>> **Menu**…**Options**…**Calibration**…**Cal Zero**…**enter**…**enter**…allow to stabilize…record 5 x 1 minute readings from iPS and monitor (must attain 0 +/- 2 ppb for both!)
    - Note: if Acceptance criteria not met, check Connections and re-run Zero Calibration Point

- Begin **Span Calibration** >>> **menu**…**Span** (225 ppb)…select **Calibration O3 Coefficient** (**000000225** should be displayed)…**enter** to Calibrate the 225 point…hit run…allow ample time to stabilize…record 5 x 1 minute readings (must attain 225 +/- 2 ppb for iPS and monitor)
    - Note: If it fails the Span acceptance criteria, check Lines for leaks and re-run the Span and allow ample time to run and stabilize (could take **30-45 minutes**)

- If Span passes, review/record the **Span Coefficient Cal factor** (0.95 to 1.05 acceptable) and **Ozone Background calibration factor** (-3 to +3 is acceptable) by the following; **menu**…**down**

arrow…highlight **Calibration Factors**…**enter**…view and record the factors and the elog workbook will auto calculate the ozone coefficient once you enter values into it

- Once Adjusted Zero and Adjusted Span meet acceptance criteria, you can now run the **3 Verification points** (180 ppb, 120 ppb, and 65 ppb)

- Start **Span 4** (Level 5)-**180 ppb** verification test >>> **Viewer**…**Operational**…**phase from Sequence**…**O3MAN**…**Span 4**…duration **01:00:00**…**Start**…observe until stability is reached…(must attain 180 ppb +/- 2 ppb for iPS and monitor)…record 5 x 1 minute values in the elog workbook once stability is met

To end the Level 5 event, hit the **Abort** key (do **not** use Stop key)

Note: If it fails the Span 4 acceptance criteria, check Lines for leaks and re-run the Span 4 and allow ample time to run and stabilize (could take 30-45 minutes)

- If Span 4 (180 ppb) passes, proceed to test/verify **Span 3** (Level 3) 120 ppb >>> **Viewer**…**Operational**…select **Phase from Sequence**…**O3MAN**…**Span 3**…**duration 01:00:00**…hit **Start**
    - View progress in **Viewer**…**Dynamic**…**Charts**…**Ozone**
- Once Stability is attained (120 ppb +/- 2 ppb) for both iPS and analyzer, then record 5 x 1 minute values into elog workbook and proceed to Span 1 (Level 2) 65 ppb event >>> to leave 120 ppb and start 65 ppb hit the **Abort** key

- Start **Span 1** (Level 2) **65 ppb** by **Menu**…**Viewer**…**Operational**…select **Phase from Sequence**…**O3MAN**…**Span 1**… 0 **duration 01:00:00**…**Start**

    - View Progress in **Viewer**…**Dynamic**…**Charts**…**Ozone**

- Once Stability is attained (65 ppb +/- 2 ppb) for both iPS and analyzer then record 5 x 1 minute values into the elog workbook
- Review the auto-populated Regression curve and label graph (optional) if desired

- Once all points are run meeting Acceptance Criteria then;
- **Congratulations**, you have successfully calibrated the Ozone analyzer!

- Please record all relevant data into the elog workbook and sign/initial!
- Make sure all data are entered into the elog workbook and adjacent 'minutes' worksheet to correspond with all entered data

- Hit **Abort** key

  Up the Channels by going to **Viewer Dynamic tabular** >>> **right click in Tabular display** >>> select **Set Channel Flag** in options box >>> select **Reset Flag** (top of dropdown list) >>> select **OK**

APPENDIX F: Glossary of Terms

Acceptance criteria – is the pollutant-specific criteria that must be met to collect valid data specified by the United States Environmental Protection Agency in their validation templates, included as Appendix D to the United States Environmental Protection Agency Quality Assurance Handbook.

Calibration – is the act of changing or setting values in a monitor.

- *Gaseous Monitor Calibration* – is the act of setting response values stored in a monitor while running a series of challenge concentrations. A calibration for a monitor is accomplished by pressing a button to change the values stored in the monitor for each challenge concentration. For carbon monoxide a calibration involves running three upscale points to set or reset the coefficients. For all other gaseous monitors, the challenge concentrations include zero and at least one span point.
- *Particulate Matter Calibration* - For low volume particulate matter monitors a calibration is the changing or resetting of the span and offset using three flow points bracketing the desired flow point. For PM monitors the temperature and pressure calibration is changing or resetting a slope using a one-point measurement. The temperature and pressure calibration must be completed before the flow calibration.

Calibration Criteria – are pollutant-specific limits established by the Division of Air Quality that a calibration must meet to pass and be used to collect valid data. The calibration criteria may be equal to or more stringent than the EPA acceptance criteria.

Control Limits – are limits established by the United States Environmental Protection Agency and published in the Code of Federal Regulations at 40 CFR Part 58 Appendix A. These limits may not be exceeded. They are listed as acceptance criteria in the Environmental Protection Agency validation tables in Appendix D to the United States Environmental Protection Agency Quality Assurance Handbook and North Carolina Division of Air Quality validation tables in the North Carolina Division of Air Quality quality assurance project plans. The precision, zero and span for gaseous monitors or flow rate verification for particulate matter monitors must be within the control limits for the collected data to be valid. Data collected when the precision, zero and span or flow rate verifications are outside of the control limits will be invalidated and replaced with a null code.

Electronics and Calibration Branch Performance Evaluation – is a check performed by the Electronics and Calibration Branch electronics technicians to confirm the correct operation of an instrument. At a minimum it involves challenging the instrument with a zero and two upscale points. One of the upscale points must be at the detection limit of the instrument. The other upscale point is either at the level of the national ambient air quality standard or at the level of the highest measured values. The Electronics and Calibration Branch electronics technicians must perform an Electronics and Calibration Branch performance evaluation on each instrument at least once every 365 days and at least once every calendar year.

Flowrate Audit - is a measurement of flow, ambient pressure and ambient temperature to ensure correct operation of the monitor, performed by someone other than the operator using a certified flow standard different from that used to calibrate or verify the monitor.

Flowrate Verification – is a measurement of flow, ambient pressure and ambient temperature by the operator to ensure correct operation of the monitor.

Functionality Test – is a test of the monitor, calibrator, cylinder, or zero air supply conducted by an ECB electronics technician, either remotely or on site, to evaluate whether the system is performing as expected. It may include running a zero and span or multiple points. Since functionality tests involving the running of points do not necessarily run the points long enough for them to stabilize and are not necessarily recorded in an elog, results of functionality tests are not reported to AQS. Functionality tests, alone, cannot be used as weight of evidence to demonstrate that the monitor is functioning properly.

Installation – is when a monitor is both taken to a site and plugged in. A leak check followed by a calibration is required on installation and before data reporting.

Manual Performance Checks – are any performance checks completed by the regional operator or Electronics and Calibration Branch electronic technician to evaluate the instrument and its performance. A manual performance check could be a precision, zero, span or just a zero and a span or just a one-point quality control check. It could be performed remotely or on-site. It includes manual 14-day one-point quality control checks performed at the site. **All Performance Checks** must be documented into an elog workbook and signed/initialed and dated.

Moving – for a gaseous monitor, is removing the monitor from the monitoring shelter.

Multi-point Verification – is the check that the operator performs after completing a calibration on a gaseous monitor. It includes running a zero, span and two (for sulfur dioxide) or three (for the other pollutants excluding ozone) intermediate, equally spaced concentrations to verify the linearity of the calibration and assess the overall success of the calibration. For ozone a multi-point verification includes running three intermediate, equally spaced concentrations. A multi-point verification may be used instead of a calibration for all pollutants except ozone, when allowed by an SOP, for the calibration required once every 365 days or when calibrators and cylinders are replaced.

National Performance Audit Program Perf**ormance Evaluation** – is a performance check completed by United States Environmental Protection Agency contractors to confirm the correct operation of an instrument. It involves challenging the instrument with a zero and several upscale points.

One-Point Quality Control Check – is a check performed at least once every two weeks on each gaseous monitor. It must fall within the range of 0.5 to 5 parts per million for carbon monoxide and 5 to 80 ppb for all other gaseous pollutants. Any check that meets the requirements of a one-point quality control check must be reported to the Air Quality System.

Precision, zero, span or PZS – is the automated scheduled check that runs each night to measure drift in the zero, span and one-point-quality control check also known as the precision point.

- ***Failed PZS*** – is a check where all of the calibration equipment worked properly to provide the desired gas at the desired concentration but the instrument failed to read the concentration within the EPA-established control limits. [Note that the action or warning limits are stricter than the control limits.] For SO_2 and O_3 the data for a failed PZS are reported to AQS. The data are invalidated back to the last passing PZS. The operator is required to take corrective action. Valid data cannot be reported until the problem is corrected or the instrument is recalibrated.
- ***Invalid PZS*** – is a check where one or more components of the calibration system (solenoid, zero air generator, gas cylinder, ozone generator, mass flow controllers, etc.) used to produce the challenge concentration failed for some reason. As a result, the system failed to provide the desired gas at the desired concentration. The operator is required to take action within two working days to identify and document the cause of an invalid PZS. The invalid PZS for ozone and sulfur dioxide is reported to the Air Quality System with a null code that describes the reason the PZS failed. Because the PZS is invalid, no data are invalidated as long as the calibration system is fixed and a passed PZS runs within 14 days. If the operator fails to act within the prescribed timeframe, the data may be flagged with a "6" for not following the standard operating procedure.
- ***Passed PZS*** – is a check where all of the calibration equipment worked properly to provide the desired gas at the desired concentration and the instrument successfully measured the concentration within the EPA-established control limits. For sulfur dioxide and ozone, the data for a passed PZS are reported to AQS. The operator is only required to take corrective action if the check is outside of the EPA Region 4 recommended warning limits for two consecutive days.
- ***Valid PZS*** – is a check where all of the calibration equipment (solenoid, zero air generator, gas cylinder, ozone generator, mass flow controllers, etc.) used to produce the challenge concentration worked properly to provide the desired gas at the desired concentration. A valid PZS is necessary to have either a passed PZS or a failed PZS. A valid PZS refers only to the status of the equipment used to produce the challenge concentration and not the monitor that measures the challenge concentration.

Shut down – is when the monitor is no longer collecting reportable data.

Startup – is when the monitor is now collecting reportable data.

Warning Limits – are limits recommended by the United States Environmental Protection Agency Region 4 and adopted by the North Carolina Division of Air Quality, which are stricter or tighter than the United States Environmental Protection Agency established control limits. The North Carolina Division of Air Quality has put them into place to minimize data loss. When the precision, zero and span for gaseous monitors or flow rate verification for particulate matter monitors are outside of the warning limits, the operator must take corrective action to identify the cause. If the cause is normal drift, the operator will recalibrate the instrument. If the cause is more serious, the instrument may be replaced or repaired and then recalibrated. Action must be taken but the data remain valid as long as the precision, zero and span or flow rate verification remains within the control limits. Data may be flagged with a "6" for not following the standard operating

procedure if the operator fails to act within the timeframe prescribed by the standard operating procedure.

Weight of evidence – is documentation and verifiable proof that the monitor or calibration system was either working properly or failed in some manner. To demonstrate the system was working properly, the weight of evidence should thoroughly document that whatever occurred at the time had no effect on the data or did not compromise the quality or validity of the data collected. To be acceptable for use as weight of evidence, any points ran must be run by the regional office staff, must be documented in an elog, and must at a minimum include a precision point, zero point and span point. Whenever points are run to provide weight of evidence that the monitor is functioning properly, they must be reported to AQS.

APPENDIX G: Guidance for Useful Logbook Documentation

EPA has been providing guidance on record keeping requirements for QA/QC programs. In particular, EPA has discussed the role that logbooks play in providing proof that QAPPs and SOPs are being followed. According to EPA, logbooks should, at a minimum, provide the following to be a useful tool for documenting the operations conducted at a monitoring site:

1. Purpose – Define the purpose of this site visit. Tell why you are there. Is it to replace a filter? Did you note something in the previous data download that is indicating a problem? Are you experiencing data drops and want to see if anything is wrong? In a couple of sentences, tell what you intend to do. Don't say routine maintenance, say instead: "noted fluctuations in flow while reviewing the 5-minute average data". Be specific.

2. Appearance – Tell how you found the site. If the site was secure, say so. If you noted a problem, or a changed condition, then document it in a couple of sentences: "construction has taken place in the vacant lot next to the site since my last visit".

3. Action – Tell what you did. In a few short sentences describe the actions you took at the site: "cleaned the PM10 head and replaced one of the two gaskets". In particular, you might want to document any site computer updates that were run. Just things like that.

4. Results – Were you successful? Did you accomplish your goals? If so, then say so: "completed the monthly and quarterly maintenance and returned the monitor to "Wait" mode". If not, then say so: "failed as-left leak check, contacted ECB".

5. Response – Is the equipment operating within specifications set in SOP? If so, then great, note that fact in the logbook and you are done. If not, then what did you do? If something is wrong then reach out for help and document it: "contacted Scott at ECB, he will be here presently with a new FRM."

6. Reviewers should add their comments: "reviewed above, approved operator action." Or: "upon review noted deviation from SOP".

OZONE ELOG SUMMARY

3	**Daily Auto-Calibration Check** is the ongoing ozone monitoring system performance evaluation tool. Each day the ozone monitor is challenged with three known ozone concentrations (0, **65**, and 225 ppb ozone). The daily performance of the ozone monitor and the on-site transfer standard must be evaluated versus the Data Acceptance Criteria Limits. The failure of the ozone monitoring system to meet the acceptance criteria requires immediate action on the part of the site operator to ensure that the most accurate ozone data possible is produced at his or her assigned ozone monitoring site. The **Daily Auto-Cal** tab of this workbook provides guidance.
4	**Changing and Conditioning of New Particulate Filters**. This protects the monitor and insures that a clean sample is being analyzed. The Routine changing and conditioning of the particulate filter is a stand alone ongoing activity through out the season. **Filter Change and Conditioning is required immediately prior to every Calibration and is required every 30 days in normal operation. The Filter Conditioning Step is no longer time based but instead as soon as the readings meet the criteria and are stable the operator is to record 5 x 1 minute readings and end the conditioning step.**
***	**Leak Testing**. This is required following all filter changes to insure the ambient air sample is not being diluted with "room air" from inside the monitoring shelter. The system must pass the leak test for the system performance to be considered acceptable. It is **highly** recommended to leak check both **pre** and **post** activity at the sites.
5	**On-Site Calibration Check** is the **required on-site operator evaluation of the ozone monitoring system when the system FAILS the Daily Auto-Calibration Check Analysis.** This on-site operator evaluation of the instrument performance is a powerful tool to ensure the highest quality ozone data possible is being produced.
	Comments Section of the On-Site Calibration Check should be used to document all problems or difficulties encountered in checking the performance of the site specific ozone monitoring system and if possible any resolution of found problems. **This record can serve as a valuable record in data validation issues and in the resolution of future problems.**
6	**Office Actuated Calibration Check** is an optional tool to evaluate the ozone monitoring system performance **remotely** when the operator believes the system is meeting data quality acceptance criteria but because of an operational anomaly the data has become questionable. An example of such is the situation where a power interruption may have occurred during the Daily Auto-Calibration Check Cycle because of an electrical storm. Another example is the system **PASSES** the **Saturday** Morning Auto-Calibration Check, **FAILS** the **Sunday** Morning Calibration Check, and then **PASSES** the **Monday** Morning Calibration Check. During these operational situations it may be more prudent to perform an Office Actuated Calibration Check to confirm the monitoring system is operating properly if no additional evidence indicates the system is producing unacceptable data. It is the regional office operator's option to utilize this evaluation tool based upon their first hand knowledge of the ongoing performance of the site specific ozone monitoring system. **If the monitoring system FAILS the Office Actuated Calibration Check and a site visit is required to correct the monitoring system performance failure.**
	Comments Section of the Office Actuated Calibration Check is critical to document the ongoing ozone system performance, the situation leading to the utilization of this evaluation tool, and the findings from this test. The completion of the Site Documentation Section is not possible during this remote performance evaluation test. In all cases the Regional Chemist the Projects and Procedures Branch Chemist, and the staff at ECB will assist as necessary.
7	**Closing Auto-Calibration Check** The November 1st Daily Auto-Calibration Check serves as the ozone monitoring season yearly final systems performance evaluation. If the November 1st Daily-Auto-Calibration Check is unavailable an On-Site Calibration Check should be performed when the Daily Auto-Cal Check does not run properly for **two days**. **This critical Check provides the closing bracket for all data collected during the year.**
8	**Ozone Logbook**
***	**Review, Sign, and Submittal** — **The Completed Ozone Logbook shall be submitted 15 days after the end of each month of operation to become part of the Permanent Site Record. The log book for each site shall be Reviewed and Signed by the Regional Chemist and Transferred to the Ambient Monitoring Central Data Storage "P Drive" of the central office computer for Review.**
	NOTE: As an aid in the review of the ozone log book a summary of the performance of the Site Transfer Standard, and the Ozone Monitor have been added to the bottom of the Calibration, the on-site Calibration Check, the Filter Conditioning, and the office actuated Cal Check Worksheets.

SUMMARY (cont.)

Additional Instructions

A

No monitor checks that interrupt the collection of ambient air ozone data are to be performed during periods of elevated or forecasted Air Quality Code Yellow or Orange or Red with AQI > 65 unless these activities are in response to any Failure of Data Acceptance Criteria

The Ambient Air Ozone Concentration must be recorded on the Site Documentation Page. Activities that require taking the ozone monitor off-line at ambient air ozone concentrations of 60 ppb and above have the potential for creating a Falsely High 8-Hr average ozone concentration and even an Exceedance.

NOTE - Unless these activities are to address any Failure of Data Acceptance Criteria.

B

Failure of the Site Transfer Standard and/or Monitor to meet the Data Acceptance Criteria

1	**All Data Acceptance Criteria Failures must be reported to Derrick House and/or James Olcott at the ECB and the PPB as they occur if possible or As Soon As Possible.**
2	**All Ozone Logbooks documenting the "Failure of Data Acceptance Criteria" must be sent to the Projects and Procedures Branch Chemist assigned to evaluate ozone monitoring system performance**

C

Ozone Sites that Operate Year Round - The ozone monitoring sites that operate year round require special considerations and procedural adaptations. Each year NCDAQ recertifies the Site Transfer Standard to establish direct traceability to the NC Standard Ozone Photometer. The site Transfer Standard is used to calibrate the site ozone monitor. To accomplish this recertification of the Site Transfer Standard and Zero Air Supply the following special procedures must be followed to ensure quality data is collected and minimize the lost of data.

1	Prior to the **removal** of Site Transfer Standard and Zero Air Supply for Recertification an **On-Site Calibration Check must be performed on the site ozone monitor.** If the site monitor Failed the immediately Prior Daily Auto-Calibration Check. Then if the Monitor passes the On-Site Calibration Check Acceptance Criteria the site Transfer Standard and Zero Air Supply may be removed for re-certification. If the monitor fails the On-Site Calibration Check the Monitor must be recalibrated. If the monitor passes calibration the site Transfer Standard and Zero Air Supply can be removed for recertification.
2	When the recertified Transfer Standard and Zero Air Supply are reinstalled at the site the site operator should first run a On-Site Calibration Check on the site monitor. If the site monitor passes the Calibration Check the operator should then calibrate the site monitor with the recertified Site Transfer Standard and Zero Air Supply to establish the direct link to the NC Standard Ozone Photometer. If the site monitor does not pass the On-Site Calibration Check with the recertified Site Transfer Standard and Zero Air Supply contact Joette Steger at (919-707-*8460) before proceeding with the calibration of the site monitor.

Projects and Procedures Branch	**Joette Steger**	**919-707-8460**
	Jeff Gobel	**919-707-8457**
Electronics and Calibration Branch	**Derrick House**	**919-715-1761**
	Scott Ginn	**919-715-1761**
	James Olcott	**919-715-1761**

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Site ACTIVITIES

NC Ambient Air Ozone Monitoring Logbook

Ozone Site Operation Activities	
	1. Installation of Equipment and Instrumentation by ECB prior to March 1st.
	2. Site Documentation and Site Inspection during each site visit.
	3. Initial Calibration of the O3 Monitor Prior to start of ozone monitoring season.
	4. Office Actuated Calibration Check to investigate performance issues remotely.
	5. On-Site Calibration Check is performed when Daily Auto P/Z/S-Check Fails

Site Activities

O3 Monitor Calibrations

Performed prior to the start of the ozone monitoring season, following All Failed On-Site Calibration Checks, and if the Transfer Standard, O3 Monitor, or the Regenerative Zero Air Supply, and any of their respective system components are repaired or replaced.

Required following all significant maintenance to either the O3 Monitor, the Transfer Standard, the Zero Air Supply or the tubing connecting these instruments. Examples of significant maintenance include the replacement of pumps, scrubbers, temperature or pressure sensors, filter holders, Teflon tubing, cell cleanings, lamp replacements, solenoid valves, detectors, flow transducers, ozone lamps, etc. Contact PPB and ECB when any and all repairs are performed and for guidance to protect data quality.

	Theoretical Ozone Concentration	Site Transfer Standard Acceptance Criteria	Site Ozone Monitor Acceptance Criteria
	0 ppb	0 ppb +/- 2.0 ppb	Transfer Std +/- 2 ppb
Prec. Pt.	65 ppb	65 ppb +/- 2.0 ppb	Transfer Std +/- 2 ppb
	120 ppb	120 ppb +/- 2.0 ppb	Transfer Std +/-2 ppb
new	180 ppb	180 ppb +/- 2.0 ppb	Transfer Std +/-2 ppb
	225 ppb	225 ppb +/- 2.0 ppb	Transfer Std +/- 2 ppb

PASS	The O3 Monitor and the Transfer Standard PASS Data Acceptance Criteria	
	Action	The O3 Monitor can begin sampling and reporting ambient air Ozone Conc.
FAIL	O3 Monitor FAILS and the Transfer Standard PASS Calibration Acceptance Criteria	
	Action	Check all calibration tubing connections and Repeat Entire Calibration Procedure including the change and conditioning of a new particulate filter
	FAIL	O3 Monitor FAILS and the Transfer Standard PASS the 2nd Calibration
	Action	Notify Region Chemist, ECB, and PPB Do not place or return the ozone Monitor to sampling ambient air mode
FAIL	Transfer Standard FAILS and the O3 Monitor PASS Calibration	
	Action	Notify ECB and PPB and make no adjustments to the O3 Monitor
	Action	Do not Place the O3 Monitor in the Sampling mode
	Action	If the calibration was being performed because Transfer Standard or Zero air supply were replaced or repaired and there have been NO adjustments made to the O3 Monitor settings then the O3 Monitor can be placed in the Ambient Air Sampling Mode and report ambient air ozone for later data review.

Site ACTIVITIES (cont.)

Particulate Filter Changes	**Particulate Filter Change - Calibration**			
	A NEW particulate filter must be installed in the filter holder, a leak check must be performed (pre and post filter change), and the filter must be Conditioned immediately prior to all O3 Monitor Calibrations.			
	PASS	**Action**	**Proceed with Calibration**	
	FAIL	**Action**	**Check the tubing and fittings for Leaks and Install and Condition a 2nd Filter**	
		PASS	**Action**	**2nd Filter Conditioning PASSES Proceed with Calibration**
		FAIL	**Action**	**2nd Filter conditioning FAILS Contact ECB and PPB before proceeding**
	Particulate Filter Change - Routine			
	Routine Particulate Filter Change and Conditioning every 30 Days or less is a key component of the ongoing efforts to protect the quality of ozone data being reported and to protect the instrumentation from contamination.			
	If the Routine Particulate Filter change and conditioning is scheduled when the Air Quality Forecast is Yellow and AQI > 65 and the Daily Auto-Calibration Check is has Passed all Acceptance Criteria the routine particulate filter change and conditioning should be postponed until the Air Quality Forecast is Code Green or Yellow with AQI < 65. This is referred to as the Air Quality Forecast Rule (see below). If necessary, due to scheduling difficulties and additional regional responsibilities the operator may arrange to have another staff member to change the filter when the forecast improves. The routine particulate filter conditioning is performance based. As soon as the filter conditioning values satisfy conditioning acceptance criteria the conditioning step is terminated.			
	9:12 Rule The operator whenever possible is encouraged to use the 9:12 Rule whenever performing a Routine Filter Change and conditioning. (see below). This will minimize the loss of valid ozone data which can lead to a false high 8-hour average			
	PASS	**Action**	**Return the O3 Monitor to the sampling air mode**	
	FAIL	**Action**	**Check the tubing and fittings for Leaks and Install and Condition a 2nd Filter**	
		PASS	**Action**	**2nd Filter Conditioning PASSES return the O3 Monitor to sampling mode**
		FAIL	**Action**	**2nd Filter conditioning FAILS Contact ECB and PPB before proceeding**

Daily Auto P/Z/S Check	**This daily performance evaluation challenges the O3 Monitor at 3 ozone concentration levels (0 ppb, 65 ppb, 225 ppb ozone) generated by the site specific Ozone Transfer Standard. The Daily 65 ppb ozone analysis results serve as the EPA REQUIRED One-Point Quality Assurance Check and is submitted to the EPA as the Precision Point Analysis. The results from this powerful tool must be evaluated early each morning.**		
	Daily Auto-Precision/Zero/Span Check Data Acceptance Criteria		
	Site Transfer Standard		**Site Ozone Monitor**
	0 ppb +/- 2 ppb		**Transfer Std +/-2 ppb**
	65 ppb +/- 2 ppb		**Transfer Std +/- 3 ppb**
	225 ppb +/- 2 ppb		**Transfer Std +/- 5 ppb**
	PASS	**O3 Monitor and the Transfer Standard PASS Acceptance Criteria**	
		Action	**No Additional Action is required and the Precision Point is reported**
	FAIL	**O3 Monitor and/or Transfer Standard FAIL Acceptance criteria**	
		Action	**A Site Visit is Required to perform a On-Site Calibration Check**

Site ACTIVITIES (cont.)

Ozone Shelter Temperature	The monitoring site is REQUIRED to be maintained between 5 - 40^0 C during all site operations including all Calibrations, Daily Auto-Calibration Checks, On-Site Calibration Checks, and daily ozone concentration measurements.		
	NOTE	All data collected and calibration checks performed at temperatures outside of the EPA Required temperature range must be Invalidated.	
	PASS	Shelter Temperature between 5- 40^0 C	
		Action	No Action Required
	FAIL	Shelter Temperature is Outside of the 5 - 40^0 C Range	
		Action	The shelter temperature must be immediately adjusted to maintain the site temp between 5 - 40^0 C to reduce the amount of data that will be invalidated due to the temperature not meeting acceptance criteria.

On-Site Calibration Check	Required when the Daily Auto-P/Z/S Check Fails to meet Acceptance Criteria. The onsite performance evaluation is performed at the 0 ppb, 65 ppb, and the 225 ppb ozone.		
	On-Site Calibration Check Data Acceptance Criteria		
	Site Transfer Standard	Site Ozone Monitor	
	0 ppb +/- 2 ppb	Transfer Std +/- 2 ppb	
	65 ppb +/- 2 ppb	Transfer Std +/- 3 ppb	
	225 ppb +/- 2 ppb	Transfer Std +/- 5 ppb	
	PASS	O3 Monitor and Transfer Standard both PASS	
		Action	No hourly ozone data is invalidated. The Auto-Calibration Data not Reported
		Action	Return the O3 Monitor to sampling ambient air.
	FAIL	O3 Monitor FAIL and the Transfer Standard PASS after a Failed Daily Auto-Cal	
		Action	Ozone data back to the most recent PASSED Auto-Cal Check, On-site Cal-Check, Calibration, or Performance Audit is Invalidated
		Action	The Failed auto calibration check data is not reported because impacted data has been invalidated.
		Action	The ozone monitor must be recalibrated
	FAIL	Transfer Standard FAIL and O3 Monitor PASS following a Failed Auto-Cal Check	
		Action	No data is invalidated. The Auto-Calibration Data not Reported
		Action	Return the O3 Monitor to sampling ambient air.
		Action	The Transfer Standard must be Replaced (Notify Regional Chemist, ECB, & PPB)
		Action	Perform an On-site Calibration Check on the site Ozone Monitor with the replacement Transfer Standard before calibrating the ozone monitor
		Action	Calibrate with Site Ozone Monitor with the Replacement Transfer Standard
	FAIL	O3 Monitor and Transfer Standard (Both FAIL)	
		Action	Ozone data back to the most recent PASSED Auto-Cal Check, On-site Cal-Check, Calibration, or Performance Audit is Invalidated
		Action	Contact ECB and Do Not return the Ozone Monitor to sampling ambient air

Site ACTIVITIES (cont.)

Office Actuated Calibration Check

Staff may actuate a Calibration Check at an ozone monitoring site from the office to investigate a performance problem that may be due to a power failure or other anomaly when existing additional data indicates that the ozone monitoring system is operating within acceptable criteria. The performance evaluation data from this quality assurance check is recorded in the Office Actuated Calibration Check section of the Logbook. A detailed explanation of observed problem and findings must be provided in the comment section.

NOTE: If the system Did Not FAIL Any Data Acceptance Criteria and the AQI Forecast is > 65 and the Ambient Air Ozone concentration is > 60 ppb then the Office Actuated Calibration Check should not be performed and the system performance should be closely monitored.

Office Actuated Calibration Check Data Acceptance Criteria	
Site Transfer Standard	Site Ozone Monitor
0 ppb +/- 2 ppb	Transfer Std +/- 2 ppb
225 ppb +/- 3 ppb	Transfer Std +/- 5 ppb

PASS	If the O3 Monitor and the Transfer Standard PASS	
	Action	No further action is required.
FAIL	If either the O3 Monitor or Transfer Standard FAILS	
	Action	A Site Visit is Required to perform an On-Site Calibration Check

Ozone Site Inspections

Site inspections are a valuable performance quality tool and must be thorough and performed during each site visit. Additional site visits solely to perform a site inspection can be beneficial and should occur as the operator determines is necessary to ensure and protect reported data quality. Additional site inspections can be site dependent if the operator is tracking a specific issue in the equipment or activities at an ozone site.

Please review the Flow Chart Of Activities Tab of this Log Book.
If you have any question please contact the Projects and Procedures Branch

Projects and Procedures Branch	Joette Steger 919-707-8460
	Jeff Gobel 919-707-8457
Electronics and Calibration Branch	Derrick House 919-715-1761
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FORECAST RULE

Version 3.46 2020

Air Quality Forecast Rule

AIR QUALITY FORECAST RULE	If the AQI Forecast for Ozone in the Region that most closely represents the ozone monitoring site is Code Yellow AQI > 65 , then all site activities that require the ozone monitor to be taken out of the ambient air sampling mode should be postponed until the Air Quality Forecast is AQI is Less Than 65.
AIR QUALITY FORECAST RULE EXCEPTION	If the ozone monitor has Failed the Daily Auto-Precision/Zero/Span Check, the performance of the ozone monitor must be immediately evaluated by the operator to ensure instrument performance is within the established data Acceptance Criteria. This includes all actions and evaluations necessary to return the ozone monitoring instrumentation and equipment performance to within performance Acceptance Criteria regardless of the Air Quality Forecast.

9:12 am Rule	It is highly recommended that site activities which require the ozone monitor to be taken out of the ambient air sampling mode be completed before 9:12 am. This specifically applies to Filter Change & Conditioning activities which is other most frequent reason for the ozone monitoring system to be taken off line. Loss of a reported 1 hour average ozone concentration can result in a falsely high 8-hour average concentration and even an Exceedance.
9:12 am Rule Exception	The Mountain Top Sites are exempt from the 9:12 am rule. Site operators should whenever possible utilize the last 12 min of an hour and the first 12 min of the following hour to minimize the loss of acceptable hourly data values
12 Minute Rule	Site activities requiring the ozone monitor to be taken out of the sampling mode can be performed during the last 15 minutes of an hour up to and including the first 15 minutes of the following hour without the invalidation of the ozone hourly averages for either hour. Fifteen (15) minutes is the absolute maximum hourly reduction allowable per the EPA 75% complete rule. A max of 30 minutes is available to take the ozone monitor offline without a reduction in reported hourly ozone concentrations. It is recommended that the operator attempt to accomplish all task from the period of 12 minutes before and after the hour (24 minutes).
	For example – If a filter is being changed and conditioned and the monitor is taken offline at 7:48 and the filter change and conditioning procedure is completed and the monitor is returned to sampling ambient air at 8:12 both the 7:00 or 8:00 hourly values are valid.

Precision/Zero/Span (PZS) Flow Chart

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Daily Auto-Precision/Zero/Span (P/Z/S) Check and Precision Point Analysis Evaluation

The Daily Ozone Auto-P/Z/S Check is the day-to-day performance metric for the Ozone Monitoring System. The Ozone Monitor is challenged daily with 3 concentrations (0 ppb, 65 ppb, and 225 ppb) of ozone generated by the Ozone Transfer Standard. The Transfer Standard has Acceptance Criteria compared to expected concentration values and the Ozone Monitor values are compared to the Transfer Standard Values.

Site Transfer Standard	Site Ozone Monitor
0 ppb +/- ≤ 2 ppb	Site Transfer (0 ppb) Value +/- ≤ 2 ppb
65 ppb +/- ≤ 2 ppb	Site Transfer (65 ppb) Value +/- ≤ 3 ppb
225 ppb +/- < 2 ppb	Site Transfer (225 ppb) Value +/- < 5 ppb

Daily Auto-Calibration Performance Evaluation and Activity Flow Chart

Ozone System PASSES

Precision Point (65 ppb) Analysis from the Daily Auto-Calibration Check is Reported to the EPA

Activities Throughout the Ozone Season

March 1 thru Oct 31, shutdown Nov

1. Review the Daily Monitor Auto-P/Z/S Check and Temperature report each morning.
2. If the temp. is outside of 5-40° C the site temp. problem must be investigated and corrected to within 5-40° C.
3. At a minimum every 30 Days a Site Inspection and Change and Condition a Particulate Filter

Filter change and conditioning is an important step in protecting the quality ozone data reported and the instrumentation.

If the Daily Auto-P/Z/S Check has PASSED Acceptance Criteria and the Particulate filter change is due but the Ozone Forecast is AQI ≥ 65.

Particulate Filter Change and Conditioning Considerations

- The filter change should be postponed until the AQI forecast is AQI < 65 (60 ppb ozone)
- If the filter change can not be postponed until the forecast is AQI < 65, the filter change and conditioning must occur when the ambient air ozone concentration at the site is < 60 ppb
- IF Filter Change & Conditioning can not be postponed until the AQI forecast is < 65 and the ozone concentration is < 60 ppb Notify the Regional Chemist and the PPB before changing and conditioning the filter in accordance to the 9:12 Rule.
- 9:12 Rule Site activities requiring the ozone monitor to be taken offline and out of the sampling mode whenever possible must be completed by 9:12 am.
- The monitor can be taken offline spanning a time period of 12 minutes before and after the hour without impacting data completeness criteria and creating a False 8-Hr Average
- The Mountain Top Sites are exempt from the 9:12 Rule for daytime activities.

4. Season Ending Daily Auto-Precision/Zero/Span Check November 1st

TRANSFER STANDARD FAILS

Notify the Regional Chemist, ECB, and PPB of the Site Transfer Standard Failure to meet Data Acceptance Criteria

On-Site Monitor Calibration Check is REQUIRED to Evaluate the Site Transfer Standard Performance

Site Inspection and Documentation

Perform On-Site Calibration Check

- Fails
- PASSES: Transfer Standard Passes On-Site Cal-Check Acceptance Criteria — See Note A. Below
- Optional: Particulate Filter Change if Needed and Air Quality Forecast is Yellow AQI <65 and Ozone Conc. is < 60 ppb — See Note A Below

Transfer Standard FAILS the On-Site Calibration Check Acceptance Criteria

1. Make No Adjustments to the Ozone Monitor. Return monitor to air sampling mode.
2. Notify the Regional Chemist, ECB, and PPB that the site Ozone Transfer Standard has Failed the On-Site Calibration Check
3. Ozone Transfer Standard must be replaced — See Note B Below

New Ozone Transfer Standard Assigned to Site

Perform a Calibration Check of the Site Ozone Monitor with the new Transfer Standard

- PASSES: Calibrate the Site Ozone Monitor with the new Site Transfer Standard
- FAILS: Make no Adjustments to the Ozone Monitor. Notify Regional Chemist, ECB, and PPB

Return to Daily Auto-Cal Performance Evaluations

Notes

Ozone Transfer Standard PASSES the On-Site Calibration Check

A	1		No Ambient Ozone Data Invalidated
	2		Daily Auto Calibration Check Precision Point is Invalidated
	3	IF	AQI forecast is < 90 and current ozone < 60ppb
			If operator schedule allows

Ozone Transfer Standard FAILS the On-Site Calibration Check

B	1	Notify PPB, ECB, Regional Chemist of Failure
	2	Return the Ozone Monitor to Sampling Mode.
	3	If it is later determined the site ozone monitor has also failed the ambient air ozone data collected during this period will be invalidated.

MONITOR FAILS

Notify the Regional Chemist, ECB, and PPB of the Ozone Monitor Failure to meet Data Acceptance Criteria

On-Site Monitor Calibration Check is REQUIRED

Site Inspection and Documentation

Perform On-Site Calibration Check

- Fails
- Passes: Monitor Passes On-Site Cal-Check Acceptance Criteria — See Note # 1 Below
- Optional: Particulate Filter Change if needed and Air Quality Forecast is Yellow AQI <65 and Ozone Conc. is < 60 ppb — See Note # 1 Below

Monitor FAILS On-Site Calibration Check Acceptance Criteria

See Note # 2 Below

- Fails: Ozone Monitor Calibration Required
- Passes

FAILS Calibration Acceptance Criteria

1. Troubleshoot Ozone Monitor
2. Notify Regional Chemist, ECB, and PPB

PASSES Calibration Acceptance Criteria

Return ozone monitor to sampling ambient air

Return to Daily Auto-Cal Performance Evaluations

Notes

Monitor PASSES the On-Site Calibration Check

1	A		No Ambient Ozone Data Invalidated
	B		Failed Auto Cal Precision Point Reported
	C		Particulate Filter Change and Conditioning
		IF	AQI forecast is < 65 and current ozone < 60ppb
			If operator schedule allows

Monitor FAILS the On-Site Calibration Check

2	A	Notify PPB, ECB, Regional Chemist of Failure
	B	All Hourly Ozone Data back to the immediately prior Satisfactory Calibration or Auto-Calibration Check or Performance Audit is Invalidated
	C	Failed Auto-Cal Check Precision Point is not Reported
	D	Full Calibration of the Ozone Monitor is Required

DOCUMENTATION WORKSHEET

Ozone Monitoring Site Documentation

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Must Be Completed First to Document Each Site Activity

Date		Note: Restart Computer Once per Month!	
		YES	NO
Site			
Operator			

Site Activity Purpose		
Calibration		Y/N
Filter Conditioning		Y/N
On-Site Cal Check		Y/N
Site Temperature		Y/N
Office Actuated Cal-Check		Y/N
Site Inspection		Y/N
Other		

Documentation for Office Actuated Calibration Check is limited to Items #1 and # 2 Below.

1	Site Temperature	Site				Adjust Site Temperature to 5 - 40 C
		DAS Temperature				
	NIST Temperature (mineral)		HOBO Temp.			Note: check HOBO Temperature before plugging it into computer, it can misread higher temps. once the HOBO is plugged into computer.
	Serial #		Site temp. must be 5-40°C for Ozone Data, Calibrations, and Checks to be Valid			
	Expiration	mm/dd/yy				
2	Record Ambient Air Ozone Conc. Ppb					Proceed with Site Activities. If the Monitor is to be taken out of sampling mode it is recommended that the 9:12 Rule be used
	Prior to Downing Data Collection Channels and the Start of All Site Activities					
	49i Time	8:44	NIST	8:43	DAS Time	8:44
	HOBO Time	8:44				Note: NIST and DAS time should be within +/- 1 minute;
			also see item 7 below*			if not, call ECB. If analyzer time is > +/- 2 min. from DAS or NIST Call ECB!

3	Site Inspection	Site Secure (Y/N)			Detail Site Inspection Exceptions and Site Activities in Comments Section Below
		Change in Activities Around Site (Y/N)			
		Sampling Line, Probe and Funnel Intact (Y/N)			
		Moisture or Debris in Sample Line (Y/N)			
***NEW ***	Heat Tape on Probe line	Is Heat Tape working (warm to touch)?	(Yes_y__) (No____)	If no, Replaced or called ECB? (Y/N)	
	*Some sites will no longer have Solar Radiator!	Solar Radiation Sensor *(If applicable)	Is the Sensor secure ? (Yes, No, n/a)		
			Does the Sensor face skyward ? (Yes, No, n/a)		
		Detail all Radiation Sensor Issues in Comment Section Below	Is the Sensor Face clean ? (Yes, No, n/a)		
			Sensor Face Cleaned during site Visit ? (Y/N)		
4	Thermo 49i Ozone Monitor	ID #		Ozone Bkg Factor	
				Ozone Coefficient Cal Factor	
		Alarms Displayed (Y/N)	n	Which Alarm ?	na
		If Alarm is Displayed contact ECB and PPB Before Proceeding			
				Cooling Fan Filter Clean (Y/N)	

DOCUMENTATION (cont.)

Lamp Intensity Evaluation				
Lamp Intensity	Cell "A"		Cell " B "	
Range 45Khz - 175Khz Monitoring the intensity provides a record for comparative purposes				

Sample Flow and Sample Line Residence Time Evaluation				
Sample Line	Install Date		Line Length (meters)	
Cell Flow LPM	Cell "A"		Cell " B "	
Cell Flow Balance (difference < +/- 0.1 lpm)			0.00	Pass
Total Sample Flow Range is 1.0 - 3.0 lpm			0.00	Total Flow Failed Contact ECB
Sample Line Residence Time Max = 20 Sec			#DIV/0!	#DIV/0!
Note	If the sample cell flow, total sample flow, or the sample line residence time evaluations "FAIL" an On-Site Calibration Check should be performed prior to the investigation to determine the cause of the failure. All Data must be invalidated back to previous Satisfactory Sample Flow and Sample Line Residence Time Determination.			
	Notify ECB and PPB of all Sample Flow and Sample Residence Time Failures			

5	49iPS- Site Transfer Standard	ID #		Certification Date	
		Alarms Displayed (Y/N)		Other Alarms (?)	
		The Flow Alarm should be Displayed Upon Arrival		All Other Alarms Contact ECB and/or PPB	
				Cooling Fan Filter Clean (Y/N)	
6	Zero Air Supply	ID#		Certification Date	
		Dew Point Sensor Indicator Light - Red or Green		If Red Contact ECB	
		Pressure Gauge (20-30 psi) (Y/N)		If "NO" Contact ECB/PPB	
7	Computer (DAS) Time	8:44	NIST (EST) time	8:43	Corrected Computer and Data Acquisition System (DAS) Y/N?
7a	HOBO time/data	HOBO to be downloaded and launched 1/month at site visit	HOBO data download DATE	Y/N? [ ]	Time match Y/N? [ ]
					Time
7b	Back up (UPS)	Back up Battery (UPS) Charged to at least 50% (and no Warning 'beep' is occurring), if not contact ECB for Replacement (Note: not all UPS's currently have power level indicators but replacement units will have)			
	addlitional site Comments				
8	Operator Comments, Problems, Discussions, Site Issues, Resolutions				
9	Regional Chemist Review Comments				

MULTI-POINT CALIBRATION/VERIFICATION

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Date	1/0/1900	Ozone Monitor Calibration	
Site	0	PA Shelter Temperature Requirement for Calibration is 5-40°	
		Site Temperature	0
Operator	0	Adjusted Site temp. (if Applicable)	
Ambient Air Ozone ppb	0		

Step One

Site Documentation Worksheet Must be completed prior to starting The Calibration Procedure

Step Two

Pre-Leak check, and Particulate Filter Change and Conditioning-Immediately Prior to All Calibrations
Post-Leak check following Filter Change and Conditioning

New Filter Y/N		Leak Checked Pre Y/N	
		Leak Checked Post Y/N	

Calibration Filter Conditioning	Filter is Conditioned for a minimum of 10 minutes after values stabilize. Then Record 5 x 1 minute values below.

Acceptance Criteria limits	IPS (cal.)	O3 (monitor)
iPS compared to Theoretical	225 ≤ ± 2 ppb	≤ i PS ± 5 ppb
O3 Compared to iPS	0 ≤ ± 2 ppb	≤ i PS ± 3 ppb

Check/Record Span Level 4 (225 ppb) and Zero and adjust to Acceptable limits as necessary; then repeat for Zero

Level 4 (Span) Event, 225 ppb		
Time		
Reading	iPS (calibrator)	O3 (monitor)
1		
2		
3		
4		
5		
Avg.	0.0	0.0
		0.0

Zero Event 0 ppb		
Time		
Reading	iPS (calibrator)	O3 (monitor)
1		
2		
3		
4		
5		
Avg.	0.0	0.0
		0.0

Filter Conditioning Evaluation
UNACCEPTABLE
Action
Check for Leaks and Recondition the Filter a Second Time or Replace with a New filter and Re-Run Conditioning Procedure

If 2nd Filter Conditioning FAILS Notify PPB and ECB!

STEP Three--Five Point Calibration Curve

Ozone Monitor Calibration Data

O3 man (Ex-Ozone) Zero Event 0 ppb		
Time		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
Diff		0.0

SPAN (Ex-Ozone) Level 4 Event 225 ppb		
Time		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
Diff		0.0

SPAN 4 (Ex-Ozone) Level 5 Event 180 ppb		
Time		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
Diff		0.0
NEW	POINT	180 ppb

Span 2 (Ex-Ozone) Level 3 Event 120 ppb		
Time		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
Diff		0.0

Span 1 (Ex-Ozone) Level 2 Event 65 ppb		
Time		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
Diff		0.0

Step Four

Calibration Evaluation

iPS Values are compared to Theoretical Values	Acceptance Criteria iPS	Acceptance Criteria O3	O3 values are compared to iPS values
	0 ppb ± 2	≤ iPS ± 2	
	65 ppb ± 2	≤ iPS ± 2	
	120 ppb ± 2	≤ iPS ± 2	
	180 ppb ± 2	≤ iPS ± 2	
	225 ppb ± 2	≤ iPS ± 2	

Site Transfer Standard	Unacceptable Performance
Monitor	Acceptable Performance

Calibration Invalid -- Site Transfer Standard Exceeds Limits Notify PPB and ECB

Step Five

Calibration Factor Evaluation

Background Factor	> - 3 & < + 3
Ozone Coefficient	>0.86 & < 1.06
Enter Monitor Background Factor	
Enter Monitor Ozone Coefficient Factor	

Unacceptable

Cal Factor Evaluation Actions	Check for Leaks and Perform Calibration Procedure a Second Time, If Second Calibration Fails Calibration Factor Evaluation Notify PPB and ECB

Step Six	Has the 49i Ozone Monitor been returned to the Lock Mode ?	Yes/No/NA	

Operator Comments	Regional Chemist Review Comments

DATE	1/0/1900	Site	1/0/00	Site Temp	0	5 - 40 C Required for Calibration
Operator			Critical Steps			Findings
0			Site Temperature			Failed Acceptance Criteria
Calibration Evaluation			Filter Conditioning			Failed Acceptance Criteria
			Site Transfer Standard			Failed Acceptance Criteria
			Ozone Monitor	Passed		
			Cal Factors			Failed Acceptance Criteria

CALIBRATION/VERIFICATION (cont.) and REGRESSION ANALYSIS

Step Seven

Ozone Monitor Calibration Verification and Regression Analysis

Multipoint Verification/Calibration Assessment

What percentage is acceptable?	2%
Calibration Scale	225
Point Difference Acceptance Value	4.5
Slope (m) Acceptance Criteria	.95 - 1.05

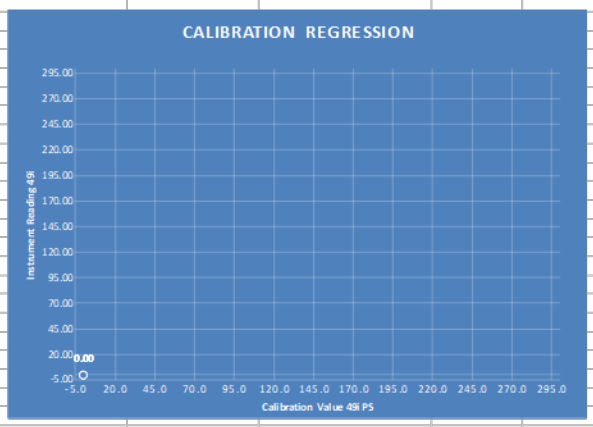
All values should fall with ± 2 ppb Acceptance Criteria Range for Calibration!

Only values on sheet that are shaded gray can be changed: Gray

	Zero Concentration	SPAN x (225 ppb) Concentration x	SPAN y (180 ppb) Concentration 3	SPAN z (120 ppb) Concentration 4	SPAN (65 ppb) Concentration 5
Calibrator Value (X)	0.00	0.00	0.00	0.00	0.00
Instrument Value (Y)	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Average	0.00	0.00	0.00	0.00	0.00
Best Fit Concentration	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute val		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc vs. Avg Y values)		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

r	slope (m_1)		intcpt (I_1)	lin reg
#DIV/0!	#DIV/0!		#DIV/0!	0.000
R	m		b	

(calibrator) 49i PS	(monitor) 49i
X	Y
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00
0.0	0.00



Slope Intercept Equation
y=mx + b

Note: To display **slope/intercept values** and R^2 **values** on the Graph---place pointer on **Trendline** and Right click mouse and Select **Format Trendline** and check the bottom two boxes on the Format Operations box

ROUTINE PARTICULATE FILTER CHANGE AND CONDITIONING

Version 3.46 2020	
Date	1/0/00
Site	1/0/00
Operator	0
Time	8:44

Routine Particulate Filter

Change and Conditioning Procedure

Performance Based.	Conditioning is not Time Based. When the Conditioning Values Pass the Acceptance Criteria the Filter is Conditioned and Values should be recorded.

The GOAL of the Routine Particulate Filter Change and Conditioning Procedure is to replace the existing particulate filter with a new conditioned filter every 30 days or less. The filters do have a finite service life due to the "potential buildup" of contaminants on the filter which can lead to falsely low reported ambient air ozone concentrations. Which can be site dependent also. The ≤ 30 day schedule for changing particulate filters does not mean the existing particulate filter at a site is negatively impacting the reported ozone concentration values. Changing particulate filters every 30 days or less is to hopefully prevent the loss of quality ozone data. Each day the performance of the particulate filter is evaluated as part of the Daily Auto-Calibration Check and Precision point Analysis.

If the Daily Auto-Calibration Check or the Immediately Prior On-Site Calibration Check PASSES Acceptance Criteria and the Ambient Air Ozone Concentration is ≥ 60 ppb with an Air Quality Forecast of Code Yellow with AQI > 65 the ozone monitor should not be taken out of the sampling mode to change and condition a new particulate filter. Doing so can create a Falsely High 8-Hr Average or even a False Exceedance. The replacement of the existing particulate filter should be re-scheduled if the operator's schedule allow them to do so. If it is not possible to reschedule a site visit then it is highly recommended for the operator to follow the 9:12 rule to minimize the loss of accurate ozone data.

HOBO Data download	Y/N? [ ]	**Reqd. 1/mo.	HOBO Time match	Y/N? [ ]

Step One

Site Documentation Must be Completed prior to Start of Filter Change and Conditioning Procedure

Step Two

Ambient Air Ozone Concentration Evaluation Prior to Filter Change and Conditioning Procedure	0.0	Proceed with Filter Change and Conditioning using the 9:12 Rule if possible.

Step Three

Filter Change and Conditioning ≤ 30 Days

Pre-Filter Change Leak Check Pass Y/N	
New Filter Installed Y/N	
Leak Check Post Filter change Pass Y/N	

FILTER CHANGE AND CONDITIONING PROCEDURE (cont.)

Acceptance Criteria

iPS Values are compared to Theoretical Values	iPS	O3	O3 values are compared to the iPS Values
	225 ≤ ± 2 ppb	≤ iPS ± 5 ppb	
	0 ≤ ± 2 ppb	≤ iPS ± 3 ppb	

STEP Four

Level 4 Event 225 ppb		
TIME		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
	-225.0	0.0

STEP Five

Zero Event 0 ppb		
TIME		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
	0.0	0.0

After Readings Stabilize Record 5 x 1 Min Values

Step Six

Site Transfer Standard Evaluation	Unacceptable
Filter Conditioning Evaluation	Filter Conditioning Acceptable

If Filter Values Fail Low a Leak at Holder or Contamination is Probable Cause
If Filters Fail High a Poor Monitor Calibration is the Probable Cause
If Site Transfer Standard Fails Contact ECB & PPB

If the Conditioning of a 2nd Particulate Filter Fails to PASS Acceptance Criteria contact ECB and PPB. Considering the Monitor passed the immediately prior Daily Auto-Calibration Check or the On-Site Calibration Check the performance of the Monitor and Sampling line is now Suspect.

Operator Comments	Regional Chemist Review Comments

Date	1/0/00	Site	1/0/00	Site Temperature	0
Operator		Critical Steps		Findings	
0		Ambient Air Ozone Concentration	0	Passed	
Filter Conditioning Evaluation		Site Transfer Standard			Failed Acceptance Criteria
		Filter Conditioning		Passed	

ON-SITE MANUAL PERFORMANCE CHECK PROCEDURE

Date	1/0/00
Site	1/0/00
Operator	0

nitial Site Temperatur	0
Site Temperature Criteria 5 - 40 c	
Applicable	

On-Site Calibration-Check

Required Following

Failed Daily Auto-Calibration Checks

Failed Office Actuated Calibration Checks

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Site Documentation must be Completed First during Each Site Visit

Time	8:44

Step One

Ambient Air Ozone Concentration Evaluation Prior to Start of the Calibration Check	0	PROCEED if the Daily Auto-Calibration Check FAILED. If possble perform this monitor evaluation step using the 9:12 Rule.

Step Two

On-Site Calibration Check

Acceptance Criteria

	iPS	O3	
iPS values are compared to Theoretical Values	0 ppb ± 2 ppb	≤ iPS ± 2 ppb	O3 Values are Compared to iPS Values
	65 ppb ± 2 ppb	≤ iPS ± 3 ppb	
	225 ppb ± 2 ppb	≤ iPS ± 5 ppb	

Zero Event		0 ppb	Level 2 Event		65 ppb	Level 4 Event		225 ppb
TIME			TIME			TIME		
Reading	iPS	O3	Reading	iPS	O3	Reading	iPS	O3
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
Avg	0.0	0.0	Avg	0.0	0.0	Avg	0.0	0.0
O3 Diff		0.0		0.0	0.0		0.0	0.0

Step Three

On-Site Calibration Check Evaluation

Site Transfer Standard	Unacceptable Performance
Ozone Monitor	Acceptable Performance
Action	Site Transfer Standard Exceeds Limits, Do Not Proceed Contact PPB and ECB

ON-SITE MANUAL PERFORMANCE CHECK PROCEDURE (cont.)

Step Four	
If the Ozone Monitor PASSES the On-Site Calibration Check Acceptance Criteria	
Ambient Air Ozone Conc.	Performing a Particulate Filter Change is Conditional
0	If the site operator has time is available, the changing and conditioning of a new sample line particulate filter is recommended only if such time will not result in the loss of an hour of monitoring data when the ambient air ozone is ≥ 60 ppb which will result in a falsely high 8-Hour average ozone concentration and potentially even a false exceedance being reported.

Operator Comments	Regional Chemist Review Comments

Date	1/0/00	Site	1/0/00	Site Temp	0	Site Temp 5-40°C Requirement

Operator	Critical Steps		Findings	
0	Ozone Concentration	0	Passed	
On-Site Calibration Check Evaluation	Site Transfer Standard			Failed Acceptance Criteria
	Ozone Monitor		Passed	

Date	1/0/00
Site	1/0/00
Operator	0

Office Actuated Calibration-Check

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If the Ozone Monitor DID NOT FAIL Daily Auto-Cal Acceptance Criteria and the Air Quality Forecast is Yellow with a AQI > 65 the Office Actuated Calibration Check should not be performed and the system performance should be closely monitored.

Site Documentation worksheet of the Logbook Must be Completed for Steps 1 and 2

Step One	
Purpose for Performing Office Actuated Calibration Check	

Step Two			
Ambient Air Ozone Concentration Evaluation Prior to Start of the Office Calibration Check	0		PROCEED if the Daily Auto-Calibration Check FAILED. If possble perform this monitor evaluation step using the 9:12 Rule.
	Time	8:44	

Step Three

Office Actuated Calibration Check

Acceptance Criteria

iPS Values are compared to Theoretical Values	iPS	O3	O3 Values are Compared to iPS Values
	0 ± 2 ppb	≤ iPS ± 3 ppb	
	225 ± 3 ppb	≤ iPS ± 5 ppb	

Zero Event 0 ppb		
TIME		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
O3 Diff		0.0

Level 4 Event 225 ppb		
TIME		
Reading	iPS	O3
1		
2		
3		
4		
5		
Avg	0.0	0.0
	0.0	

Step Four

Office Actuated Cal-Check Evaluation

Site Transfer Standard	Unacceptable Performance
Ozone Monitor	Acceptable Performance
Action	Site Transfer Standard Exceeds Limits, Onsite Calibration Check Required - Contact PPB and ECB

Operator Comments	Regional Chemist Review Comments

Date	1/0/00	Site	1/0/00	Site Temp	0	Site Temp 5-40°C Requirement

Operator	Critical Steps		Findings	
0	Ozone Concentration	0	Passed	
Office Actuated Calibration Check Evaluation	Site Transfer Standard			Failed Acceptance Criteria
	Ozone Monitor		Passed	

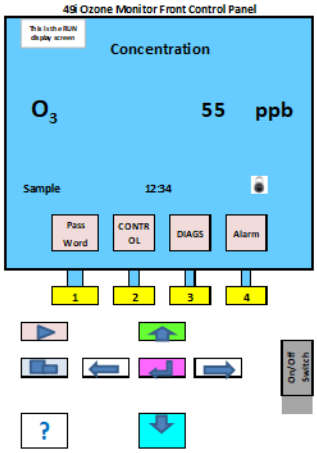
New: Minutes Data Tab (Example)

2/8/2018 9:18 AM	228.7	Calib	224.7	Ok
2/8/2018 9:19 AM	229.1	Calib	224.9	Ok
2/8/2018 9:20 AM	229.4	Calib	225.2	Ok
2/8/2018 9:21 AM	229.5	Calib	224.9	Ok
2/8/2018 9:22 AM	229.5	Calib	225.1	Ok
2/8/2018 9:23 AM	199.7	Calib	181.7	Ok
2/8/2018 9:24 AM	24.4	Calib	12.7	Ok
2/8/2018 9:25 AM	-6.1	Calib	0.6	Ok
2/8/2018 9:26 AM	-2.6	Calib	0.5	Ok
2/8/2018 9:27 AM	-1.8	Calib	0.6	Ok
2/8/2018 9:28 AM	-1.1	Calib	0.5	Ok
2/8/2018 9:29 AM	-0.4	Calib	0.6	Ok
2/8/2018 9:30 AM	-0.3	Calib	0.6	Ok
2/8/2018 9:31 AM	-0.1	Calib	0.4	Ok
2/8/2018 9:32 AM	0	Calib	0.6	Ok
2/8/2018 9:33 AM	0	Calib	0.7	Ok
2/8/2018 9:34 AM	0.1	Calib	0.4	Ok
2/8/2018 9:35 AM	0.3	Calib	0.6	Ok
2/8/2018 9:36 AM	0.2	Calib	0.5	Ok
2/8/2018 9:37 AM	0.4	Calib	0.4	Ok
2/8/2018 9:38 AM	0.3	Calib	0.6	Ok
2/8/2018 9:39 AM	0.4	Calib	0.5	Ok
2/8/2018 9:40 AM	0.6	Calib	0.5	Ok
2/8/2018 9:41 AM	0.6	Calib	0.4	Ok
2/8/2018 9:42 AM	0.4	Calib	0.5	Ok
2/8/2018 9:43 AM	0.3	Calib	0.5	Ok
2/8/2018 9:44 AM	0.3	Calib	0.5	Ok
2/8/2018 9:45 AM	0.5	Calib	0.4	Ok
2/8/2018 9:46 AM	0.6	Calib	0.5	Ok
2/8/2018 9:47 AM	0.5	Calib	0.5	Ok
2/8/2018 9:48 AM	0.5	Calib	0.4	Ok
2/8/2018 9:49 AM	-0.1	Calib	0.6	Ok
2/8/2018 9:50 AM	-0.2	Calib	0.5	Ok
2/8/2018 9:51 AM	-0.1	Calib	0.6	Ok
2/8/2018 9:52 AM	-0.2	Calib	0.5	Ok
2/8/2018 9:53 AM	-0.1	Calib	0.6	Ok
2/8/2018 9:54 AM	-0.1	Calib	0.5	<Samp
2/8/2018 9:55 AM	-0.2	Calib	0.5	Ok
2/8/2018 9:56 AM	0	Calib	0.6	Ok
2/8/2018 9:57 AM	0.1	Calib	0.6	Ok
2/8/2018 9:58 AM	85.8	Calib	131.8	Ok
2/8/2018 9:59 AM	227.3	Calib	227.7	Ok
2/8/2018 10:00 AM	226.7	Calib	225.5	Ok

MANUAL PERFORMANCE CHECK FLOW CHART (generic)

Calibration Steps on the 49i Ozone Monitor

49i Ozone Monitor Front Control Panel



Front Panel Pushbuttons

- Display Shortcuts — Accessed via use the soft key below
- 1-4 Soft Keys — To access the identified display Shortcuts
- Run Key — To display the Run Screen and Ozone
- Menu — Displays the Main Menu when in the Run Screen or to move back up a level in the Menu
- Help — Information about the displayed screen
- Enter Key — used to select a menu item; To accept To set To save a change; To toggle between functions
- Used to move the cursor and change values
- The system is Locked and No Adjustments Can be Made

1	Press	1	To access Password Function to unlock the system
2	Press	↵	Twice slowly to unlock the Monitor — Note #1
3	Press	▶	To return to the Sample Screen
4	Start the Zero Span Event on the Envidas (DAS) Computer System — Note # 2		
5	Press	Menu	This will bring up the Menu Options
6	Press	↓	Use down arrow to Highlight Calibration
7	Press	↵	To select Calibration
8	Press	↓	Use down arrow to highlight Cal ZERO
9	Press	↵	To select Cal ZERO
10	Allow Zero Event Readings to Stabilize on the Calibrator and the Monitor — Note # 3		
11	Press	↵	To Calibrate the ZERO Point
12	Press	▶	To Return to the Sample Screen
13	When Readings are stable -- Record 5 x 1-Minute Zero Point Averages for the Zero Point from the Envidas (DAS) for the Calibrator and the Monitor in the Ozone Logbook		
14	Stop the Zero Event & Start the Level 4 Span (225 ppb) Event on the Computer System — Note # 2		
15	Press	Menu	This will bring up the Menu Options
16	Press	↓	Use down arrow to Highlight Calibration
17	Press	↵	To select Calibration
18	Press	↓	Use down arrow to highlight Cal O_3 Coeff
19	Press	↵	To select Cal O_3 Coeff
20	The Calibrate O3 Screen should be displayed. The Span Concentration should be 00000225 If true proceed to step 21 if not see Note 4 A-D to adjust Span Setting		
21	Allow Level 4 (225ppb) Event Readings to Stabilize on the Calibrator and Monitor — Note # 3		
22	Press	↵	To calibrate the Cal O_3 Coeff (level 4) Point
23	Press	▶	To Return to the Sample Screen
24	When Readings are stable -- Record 5 x 1-Minute Level 4 Event Averages from the Data Logger for the Calibrator and the Monitor in the Ozone Logbook		
25	Review the Ozone Logbook Calibration Performance Evaluation. If PASSES Acceptance Criteria Proceed to Step 26. If FAILED repeat steps 4 through 25		
26	Press	Menu	This will bring up the Menu Options
27	Press	↓	Use down arrow to Calibration Factors
28	Press	↵	To select Calibration Factors
	Record the O3 Bkg Factor and the O3 Coef in the Ozone Logbook.		
29	Review the Ozone Log Book Evaluation of O3 Bkg Factor and O3 Coeff Factor. If PASSES Acceptance Criteria proceed to Step 30. If FAILED repeat Steps 4 through 29		
30	Stop Level 4 & Start Level 5 (180ppb) NEW Event on the Computer System — Note#2 and 3		
31	When the readings are stable -- Record 5 x 1-Minute Level 4 Event Averages from the Data Logger for the Calibrator and the Monitor in the Ozone Logbook; Stop Level 4 & Start Level 3 (120ppb) Event on the Computer System — Note # 2 & #3		
32	When the readings are stable -- Record 5 x 1-Minute Level 3 Event Averages from the Data Logger for the Calibrator and the Monitor in the Ozone Logbook; Stop Level 3 & Start Level 2 (65ppb) Event on the Computer System — Note # 2 & 3		
33	When the readings are stable -- Record 5 x 1-Minute Level 2 Event Averages from the Data Logger for the Calibrator and the Monitor in the Ozone Logbook		
34	Review the Ozone Log Book Calibration Evaluation (Zero, Levels 4, 3, & 2). If PASSES Acceptance Criteria proceed to Step 35. If FAILED repeat Steps 4 through 34		
35	Stop the Level 2 (65 ppb) Event on the Computer System		
36	Press 1	Press ↵	Press ↵ — Note #5

Notes

1	There is a slight delay in monitor response Lock Symbol on display will disappear
2	Monitor display will change to Span
3	Calibrator and Monitor Response during span cycles is erratic at first but will stabilize
4A	Calibrate O3 Coeff Display Screen
	Calibrate O3: O3: Reading Span Conc 00000225 ?
4B	The SPAN CONC: should be 00000225
4C	If "SPAN CONC: is NOT 00000225 proceed below
Press ↓	To Highlight SPAN CONC:
Press ← Or →	To Select Digit
Press ↑ Or ↓	To Set Value Up/Down
4D	Return to Step 20
# 5	The 49i Ozone Monitor is now Password protected and is in the Sample Mode

Operator Notes

Envidas/Envista new nomenclature as of Mar. 1, 2017

Span=Level 4=225 ppb
Span 4=Level 5=180 ppb
Span 3=Level 3=120 ppb
Span 1= Level 2 =65 ppb
Zero = Zero, but on Calibrator it is Level 6 (new)
Span 2 = Level 1 = 50 ppb (not currently used)
Span 5 = Level 5 = 300 ppb (not currently used)