APPROVAL SIGN OFF-SHEET

I certify that I have read and approve of the contents of the Model 49i UV Photometric Ozone (O₃) Analyzer Monitoring System-Operator Responsibilities Standard Operating Procedure Section 2.7.2 with an effective date of March 1, 2020.

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Date</th>
<th>Signature</th>
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</thead>
<tbody>
<tr>
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<td>Michael Abraczinskas</td>
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</tr>
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<td>Interim Director, Western North Carolina Regional Air Quality Agency</td>
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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 multipoint 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 All 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. **If the operator has any concern for personal safety the operator should not proceed with the site visit.** 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

<table>
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<th>Step</th>
<th>Item</th>
<th>Enter</th>
<th>Example Only</th>
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<tbody>
<tr>
<td>1.</td>
<td>Date of the Site Visit</td>
<td>5/4/2017</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Site Name</td>
<td>Millbrook</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Site Operator Name</td>
<td>J. Doe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Choose Activity (Check box)</td>
<td>Onsite-Cal Check</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DAS Temperature from the monitor</td>
<td>“20.3”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(mineral thermometer temp.)</td>
<td>“20.5”</td>
<td></td>
</tr>
<tr>
<td></td>
<td>As is, on face of HOBO thermometer</td>
<td>“20.2”</td>
<td></td>
</tr>
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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”

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 Sensor 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

<table>
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<th>TEI 49i Ozone Monitor Operational Limits</th>
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<td><strong>Bench Temp</strong></td>
</tr>
<tr>
<td><strong>Bench Lamp</strong></td>
</tr>
<tr>
<td><strong>Ozone Lamp</strong></td>
</tr>
<tr>
<td><strong>Pressure</strong></td>
</tr>
<tr>
<td><strong>Flow Cell A &amp; B</strong></td>
</tr>
<tr>
<td><strong>Intensity Cell A &amp; B</strong></td>
</tr>
</tbody>
</table>

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”
  o **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.

<table>
<thead>
<tr>
<th>Sample Tubing (meters)</th>
<th>Residence Time (Seconds) at Flow Rates</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Flow Rate = 1.0 lpm</td>
</tr>
<tr>
<td>5</td>
<td>3.7</td>
</tr>
<tr>
<td>10</td>
<td>7.5</td>
</tr>
<tr>
<td>15</td>
<td>11.2</td>
</tr>
<tr>
<td>20</td>
<td>14.9</td>
</tr>
<tr>
<td>25</td>
<td>18.7</td>
</tr>
<tr>
<td>26</td>
<td>19.4</td>
</tr>
<tr>
<td>40</td>
<td>19.9</td>
</tr>
</tbody>
</table>

**Note:** Less than 20 seconds Residence time is required
At a Flow Rate of 1.0 lpm the maximum sample tube length is 26 Meters
At a Flow Rate of 1.5 lpm the maximum sample 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**
  - “2/23/2013”

- **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**

**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:

<table>
<thead>
<tr>
<th>Envista software</th>
<th>Calibrator</th>
<th>Level</th>
<th>Comment(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span</td>
<td>225 ppb</td>
<td>Level 4</td>
<td></td>
</tr>
<tr>
<td>Span 4</td>
<td>180 ppb</td>
<td>Level 5</td>
<td>New for 2020 season</td>
</tr>
<tr>
<td>Span 3</td>
<td>120 ppb</td>
<td>Level 3</td>
<td></td>
</tr>
<tr>
<td>Span 1</td>
<td>65 ppb</td>
<td>Level 2</td>
<td></td>
</tr>
<tr>
<td>Span 2</td>
<td>50 ppb</td>
<td>Level 1</td>
<td>not currently used</td>
</tr>
<tr>
<td>Zero</td>
<td>0 ppb</td>
<td>Level 6</td>
<td></td>
</tr>
</tbody>
</table>

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 at least 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**

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>49i (analyzer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span: 225 ppb +/- 2 ppb</td>
<td>Span: 225 ppb +/- 5 ppb</td>
</tr>
<tr>
<td>Zero: 0 +/- 2 ppb</td>
<td>Zero: 0 +/- 3 ppb*</td>
</tr>
</tbody>
</table>

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 not 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 readings 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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb (+/- 2ppb)</td>
<td>0 ppb (+/- 3 ppb)</td>
</tr>
<tr>
<td>225 ppb (+/- 2ppb)</td>
<td>225 ppb (+/- 5 ppb)</td>
</tr>
</tbody>
</table>

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 (0 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 O3 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.

<table>
<thead>
<tr>
<th></th>
<th>iPS</th>
<th>O3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb +/- 2ppb</td>
<td>ipS +/- 2ppb</td>
<td></td>
</tr>
</tbody>
</table>

○ 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 O3 and O3CAL 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.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>iPS (calibrator)</td>
<td>O3 (monitor)</td>
</tr>
<tr>
<td>225 ppb +/- 2 ppb</td>
<td>iPS (cal) +/- 2 ppb</td>
</tr>
</tbody>
</table>

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 Calibration (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 O₃ and O₃CAL 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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 ppb +/- 2 ppb</td>
<td>iPS +/- 2 ppb</td>
</tr>
</tbody>
</table>

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, then RE-RUN the Level 5 Event and patiently allow time to stabilize. 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 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 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”.
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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 ppb +/- 2 ppb</td>
<td>iPS (cal) +/- 2 ppb</td>
</tr>
</tbody>
</table>

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 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 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”.
    o Hit **Start** (phase will show countdown and start at top of minute)
• View progress in **Viewer >> 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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 ppb +/- 2 ppb</td>
<td>iPS (cal) +/- 2 ppb</td>
</tr>
</tbody>
</table>

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 +/- 2 ppb, 120 +/- 2 ppb, 65 +/- 2 ppb).

*If desired, the operator can add the slope/intercept equation and R² 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:

<table>
<thead>
<tr>
<th>Theoretical Concentration</th>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb</td>
<td>0 ppb +/- 2 ppb</td>
<td>iPS +/- 2 ppb</td>
</tr>
<tr>
<td>65 ppb</td>
<td>65 ppb +/- 3 ppb</td>
<td>iPS +/- 3 ppb</td>
</tr>
<tr>
<td>225 ppb</td>
<td>225 ppb +/- 3 ppb</td>
<td>iPS +/- 5 ppb</td>
</tr>
</tbody>
</table>

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 O₃ sites (sent daily)

| Ozone Daily Auto-Calibration Check and Precision Point Evaluation | Monitor Evaluation | Temp. Range | AQI Forecast | Forecast Source |
|---|---|---|---|---|---|
| 31-Jul-17 | IPS | IPS Evaluation | IPS Evaluation | IPS Evaluation | IPS Evaluation | IPS Evaluation |
| Joanna Bald | 0.0 | 64.0 | 225.0 | 0.0 | 64.0 | 225.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Frying Pan | 0.0 | 65.0 | 225.0 | 0.0 | 65.0 | 226.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Mt Mitchell | 0.0 | 65.0 | 224.0 | 0.0 | 64.0 | 224.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Purchase Knob | 0.0 | 65.0 | 225.0 | 0.0 | 64.0 | 224.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Linville Falls | 0.0 | 64.0 | 225.0 | 0.0 | 64.0 | 224.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Bryson City | 0.0 | 64.0 | 225.0 | 0.0 | 65.0 | 225.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Waynesville | 0.0 | 64.0 | 225.0 | 0.0 | 65.0 | 226.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Bent Creek | 0.0 | 65.0 | 225.0 | 0.0 | 65.0 | 224.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Lenoir | 0.0 | 65.0 | 225.0 | 0.0 | 64.0 | 223.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Monroe | 0.0 | 65.0 | 224.0 | 0.0 | 64.0 | 226.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Crouse | 0.0 | 65.0 | 224.0 | 0.0 | 64.0 | 223.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Rockwell | 0.0 | 64.0 | 225.0 | 0.0 | 64.0 | 225.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Liledoun | 0.0 | 64.0 | 225.0 | 0.0 | 64.0 | 225.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Bethany | 0.0 | 65.0 | 225.0 | 0.0 | 64.0 | 224.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Mendenhall | 0.0 | 65.0 | 225.0 | 0.0 | 63.0 | 222.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Cherry Grove | 0.0 | 65.0 | 225.0 | 0.0 | 64.0 | 224.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Wade | 0.0 | 65.0 | 225.0 | 0.0 | 64.0 | 225.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Honeycutt | 0.0 | 64.0 | 225.0 | 0.0 | 65.0 | 225.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Blackstone | 0.0 | 64.0 | 225.0 | -1.0 | 63.0 | 223.0 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

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 - 40°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 - 40°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:
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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb</td>
<td>0 ppb +/- 2 ppb</td>
</tr>
<tr>
<td>225 ppb</td>
<td>225 ppb +/- 5 ppb</td>
</tr>
</tbody>
</table>

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.

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

  o 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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb ≤ +/- 2 ppb</td>
<td>iPS ≤ +/- 2 ppb</td>
</tr>
<tr>
<td>65 ppb ≤ +/- 2 ppb</td>
<td>iPS ≤ +/- 3 ppb</td>
</tr>
<tr>
<td>225 ppb ≤ +/- 2 ppb</td>
<td>iPS ≤ +/- 5 ppb</td>
</tr>
</tbody>
</table>

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 at least 1 hour 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-Office Actuated Manual Performance Check 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 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); Hence use the Abort key to Stop!
- 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” (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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb &lt; +/- 2 ppb</td>
<td>iPS &lt; +/- 2 ppb</td>
</tr>
<tr>
<td>225 ppb &lt; +/- 2 ppb</td>
<td>iPS &lt; +/- 5 ppb</td>
</tr>
</tbody>
</table>

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.

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

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 theReviewed Monthly Ozone Concentration Data and Precision Point Analysis Reports Level 3 final approval to the Data 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.

<table>
<thead>
<tr>
<th>Potential Problem</th>
<th>Potential Symptom</th>
<th>Action or Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative O3 Values</td>
<td>Possible stuck solenoid during PZS checks</td>
<td>Try running remotely, then on-site, then if all else fails contact ECB</td>
</tr>
<tr>
<td>Negative O3 Values</td>
<td>Loose connection on circuit board to calibrator</td>
<td>Check leads and connections (wiggle test)</td>
</tr>
<tr>
<td>Negative O3 Values</td>
<td>Possible bad Ozonator lamp—check A/B intensities</td>
<td>If checked twice and still bad, contact ECB</td>
</tr>
<tr>
<td>Negative or erratic O3 values</td>
<td>Water in sample line or clogged probe port</td>
<td>Dry line, replace and condition filter, Z/S check</td>
</tr>
<tr>
<td>Excessively High O3 Values</td>
<td>Solenoid stuck/not switching; moisture in drain</td>
<td>Dry line, replace and condition filter, Z/S check</td>
</tr>
<tr>
<td>Not reaching high point in PZS checks</td>
<td>Bad Ozonator</td>
<td>Test Zero and Span points and if still bad call ECB</td>
</tr>
<tr>
<td>High value stuck, low value leaking down</td>
<td>Intra-line leak—perform leak test to check</td>
<td>If leak test fails, check all connections and call ECB</td>
</tr>
<tr>
<td>Autocal drifting, monitor following calibrator</td>
<td>Bad Calibrator</td>
<td>Run P/Z/S and allow time for points to stabilize, if still bad try Calibration with Verification</td>
</tr>
<tr>
<td>Drifting Values</td>
<td>Leak(s), noise, Bad Ozonator lamp</td>
<td>Run leak test and Run lamp intensity test</td>
</tr>
<tr>
<td>Data Loss</td>
<td>Comm. Port disconnected, power surge, breaker trip</td>
<td>Check all electrical connections, plugs, UPS, and confirm channels are reset</td>
</tr>
<tr>
<td>Unusually Low O3 Values</td>
<td>Moisture in Lines/filter</td>
<td>Dry line(s), replace and condition filter, run P/Z/S</td>
</tr>
<tr>
<td>Lack of variation in daily O3 monitoring data</td>
<td>Operator error—forgot to plug sample line in after routine maintenance</td>
<td>Run remote Z/S first and follow up at site visit if necessary and check connections</td>
</tr>
<tr>
<td>Cannot achieve Acceptance limits on site maintenance checks</td>
<td>Need to allow more time to burn in filter after changing/replacing</td>
<td>Rerun PZS points and allow adequate time to stabilize</td>
</tr>
<tr>
<td>Potential Problem</td>
<td>Potential Symptom</td>
<td>Action or Correction</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>‘AI’ flag in data</td>
<td>Check minute data for power surge and correct/label</td>
<td>Check and edit with appropriate Code if necessary and save/validate</td>
</tr>
<tr>
<td>Continuous ‘BA’ code displayed from site</td>
<td>Operator forgot to reset (up) the channel when finished with site visit/maintenance</td>
<td>Reset the channels per SOP instructions</td>
</tr>
<tr>
<td>Moisture in probe line/filter housing</td>
<td>A/C diffusers aimed at line, heat tape not working, site temp. not set properly, ck. Sample line also</td>
<td>Correct as appropriate at site visit and Document in elog workbook</td>
</tr>
<tr>
<td>Too long residence time (&gt;20 sec)</td>
<td>Leak in system</td>
<td>Leak test, replace filter, test again and check all lines and connections; Run P/Z/S as appropriate</td>
</tr>
<tr>
<td>Incorrect flow (&lt;1 lpm or &gt;3 lpm)</td>
<td>Check all lines for leaks</td>
<td>If no leak discovered, contact ECB</td>
</tr>
<tr>
<td>Incorrect cell flow balance (&lt;+/- 0.1 lpm)</td>
<td>Stuck solenoid or leak in system</td>
<td>Try to run P/Z/S, if no success follow up with ECB</td>
</tr>
<tr>
<td>Lamp intensity (&lt;45 kHz or &gt;175kHz) or &gt;20kHz difference in Cell A and Cell B</td>
<td>Dirty mirror(s), dirty cell, debris stuck in a tube, call ECB on this one</td>
<td>Contact ECB for specific instructions</td>
</tr>
<tr>
<td>Ozone Background Factor bad (&lt;-3 or &gt;+3)</td>
<td>Check for leaks and loose connections and Retest Factor check</td>
<td>If bad after second check, contact ECB</td>
</tr>
<tr>
<td>Ozone Coefficient Cal Factor bad (&lt;0.95) (Normal 0.95 – 1.05)</td>
<td>Rerun Cal check a second time</td>
<td>If bad after checks, contact ECB</td>
</tr>
<tr>
<td>Ozone Coefficient Cal Factor bad (&gt;1.05)</td>
<td>Leak suspected; ck. Lines, filter, solenoids, connections</td>
<td>Rerun Factor test and if bad after second check, contact ECB</td>
</tr>
<tr>
<td>Pressure on ZAP not to spec (20-30 psi)</td>
<td>Bad pump, filter, leak, clogged drain line</td>
<td>If no leaks and line cleared, contact ECB</td>
</tr>
<tr>
<td>UPS backup battery displaying &lt;50% charge</td>
<td>Replace battery</td>
<td>If no good after new battery, contact ECB</td>
</tr>
</tbody>
</table>
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


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.
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:

<table>
<thead>
<tr>
<th>iPS (calibrator)</th>
<th>O3 (monitor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb +/-2 ppb</td>
<td>0 ppb +/- 2 ppb (-2 to +2 ppb)</td>
</tr>
<tr>
<td>225 ppb</td>
<td>225 ppb +/- 5 ppb (220-230 ppb)</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Ozone System</th>
<th>TRANSFER STANDARD</th>
<th>MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PASSES</strong></td>
<td><strong>FAILS</strong></td>
<td><strong>FAILS</strong></td>
</tr>
<tr>
<td>Precision Point (65 ppb) Analysis from the Daily Auto-Calibration Check is <strong>PASSES</strong> to the EPA</td>
<td>Notify the Regional Chemist, ECB, and PPB of the Ozone Monitor Failure to meet Data Acceptance Criteria</td>
<td>Notify the Regional Chemist, ECB, and PPB of the Ozone Monitor Failure to meet Data Acceptance Criteria</td>
</tr>
<tr>
<td>Activities Throughout the Ozone Season</td>
<td>On-Site Monitor Calibration Check is REQUIRED to Evaluate the Site Transfer Standard Performance</td>
<td>On-Site Monitor Calibration Check is REQUIRED to Evaluate the Site Transfer Standard Performance</td>
</tr>
<tr>
<td>Review the Daily Monitor Auto-P/Z/S Check and Temperature report each morning</td>
<td>Site Inspection and Documentation</td>
<td>Site Inspection and Documentation</td>
</tr>
<tr>
<td>If the temp. is outside of 5-40o C the site temp. problem must be investigated and corrected to within 5-40o C</td>
<td>Perform On-Site Calibration Check</td>
<td>Perform On-Site Calibration Check</td>
</tr>
<tr>
<td>Filter change and conditioning is an important step in protecting the quality ozone data reported and the instrumentation.</td>
<td>Transfer Standard Passes On-Site Check Acceptance Criteria</td>
<td>Monitor Passes On-Site Check Acceptance Criteria</td>
</tr>
<tr>
<td>The filter change should be postponed until the AQI forecast is AQI &gt; 65.</td>
<td>Regional</td>
<td>See Note A Below</td>
</tr>
<tr>
<td>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 &lt; 65.</td>
<td>Particulate Filter Change if Needed</td>
<td>See Note A Below</td>
</tr>
<tr>
<td>The filter change cannot be postponed until the forecast is AQI &gt; 65 the filter change and conditioning must occur when the ambient air ozone concentration at the site is &lt; 60 ppb</td>
<td>Ozone Cont. is &lt; 60 ppb</td>
<td>Ozone Cont. is &lt; 60 ppb</td>
</tr>
<tr>
<td>If Filter Change &amp; Conditioning can not be postponed until the AQI forecast is &lt; 65 and the ozone concentration is &lt; 60 ppb. Notify the Regional Chemist and the PPB before changing and conditioning the filter in accordance to the 9:12 Rule.</td>
<td></td>
<td>See Note B Below</td>
</tr>
<tr>
<td>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.</td>
<td>New Ozone Transfer Standard Assigned to Site</td>
<td>New Ozone Transfer Standard Assigned to Site</td>
</tr>
<tr>
<td>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 B-H Average.</td>
<td>Perform a Calibration Check of the Site Ozone Monitor with the new Transfer Standard</td>
<td>Perform a Calibration Check of the Site Ozone Monitor with the new Transfer Standard</td>
</tr>
<tr>
<td>The Mountain Top Sites are exempt from the 9:12 Rule for daytime activities.</td>
<td>Calibrate the Site Ozone Monitor with the new transfer standard</td>
<td>Calibrate the Site Ozone Monitor with the new transfer standard</td>
</tr>
<tr>
<td>Season Ending Daily Auto-Precision/Zero/Span Check November 1st</td>
<td>Ozone Monitor Calibration Required</td>
<td>Ozone Monitor Calibration Required</td>
</tr>
</tbody>
</table>

**Notes**

- **Ozone Transfer Standard PASSES the On-Site Calibration Check**
  - A: No Ambient Ozone Data Invaludated
  - B: Daily Auto Calibration Check Precision Point is Invaludated
  - C: AQI forecast is < 65 and current ozone < 60ppb

- **Ozone Transfer Standard FAILS the On-Site Calibration Check**
  - A: Notify PPB, ECB, Regional Chemist of Failure
  - B: Return the Ozone Monitor to Sampling Mode.
  - C: If it is later determined the site ozone monitor has also failed the ambient air ozone data collected during this period will be Invaludated.

- **Ozone Monitor PASSES**
  - A: No Ambient Ozone Data Invaludated
  - B: Failed Auto Cal Precision Point Reported
  - C: Particulate Filter Change and Conditioning
  - D: AQI forecast is > 65 and current ozone > 60ppb

- **Ozone Monitor FALS the On-Site Calibration Check**
  - 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 Invaludated
  - C: Failed Auto Cal 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 must be run first!)  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 (0000000225 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
…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… 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 Performance 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 SO₂ and O₃ 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”.
### 13.0 OZONE ELOG WORKBOOK

#### OZONE ELOG SUMMARY

<table>
<thead>
<tr>
<th>3</th>
<th><strong>Daily Auto-Calibration Check</strong> 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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Changing and Conditioning of New Particulate Filters</strong> 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 throughout the season. <strong>Filter Change and Conditioning is required immediately prior to every Calibration and is required every 30 days in normal operation.</strong> 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. <strong>Leak Testing</strong> 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.</td>
</tr>
<tr>
<td>5</td>
<td><strong>On-Site Calibration Check</strong> 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. <strong>Comments Section of the On-Site Calibration Check</strong> 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.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Office Actuated Calibration Check</strong> 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 <strong>PASSES</strong> the Saturday Morning Auto-Calibration Check, FAILS the Sunday Morning Calibration Check, and then <strong>PASSES</strong> 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. <strong>If the monitoring system FAILS the Office Actuated Calibration Check and a site visit is required to correct the monitoring system performance failure.</strong> <strong>Comments Section of the Office Actuated Calibration Check</strong> 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.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Closing Auto-Calibration Check</strong> 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.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Ozone Logbook</strong> 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. <strong>Review, Sign, and Submit</strong></td>
</tr>
</tbody>
</table>

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**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.

### 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 Oclott 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.

### 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 loss 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 fails 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

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joette Steger</td>
<td>919-707-8460</td>
</tr>
<tr>
<td>Jeff Gobel</td>
<td>919-707-8457</td>
</tr>
</tbody>
</table>

### Electronics and Calibration Branch

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derrick House</td>
<td>919-715-1761</td>
</tr>
<tr>
<td>Scott Ginn</td>
<td>919-715-1761</td>
</tr>
<tr>
<td>James Oclott</td>
<td>919-715-1761</td>
</tr>
</tbody>
</table>
### 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 PZS-Check Fails

---

**Site Activities**

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.

<table>
<thead>
<tr>
<th>Theoretical Ozone Concentration</th>
<th>Site Transfer Standard Acceptance Criteria</th>
<th>Site Ozone Monitor Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prec. Pt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 ppb</td>
<td>0 ppb +/- 2.0 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
</tr>
<tr>
<td>65 ppb</td>
<td>65 ppb +/- 2.0 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
</tr>
<tr>
<td>120 ppb</td>
<td>120 ppb +/- 2.0 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
</tr>
<tr>
<td><strong>new 180 ppb</strong></td>
<td>180 ppb +/- 2.0 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
</tr>
<tr>
<td>225 ppb</td>
<td>225 ppb +/- 2.0 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
</tr>
</tbody>
</table>

**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 **FAILS** 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 **FAILS** 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 **FAILS** 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 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.

<table>
<thead>
<tr>
<th>PASS</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proceed with Calibration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check the tubing and fittings for Leaks and Install and Condition a 2nd Filter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PASS</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd Filter Conditioning PASSES Proceed with Calibration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd Filter conditioning FAILS Contact ECB and PPB before proceeding</td>
</tr>
</tbody>
</table>

**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 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 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.

<table>
<thead>
<tr>
<th>PASS</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Return the O3 Monitor to the sampling air mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check the tubing and fittings for Leaks and Install and Condition a 2nd Filter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PASS</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd Filter Conditioning PASSES return the O3 Monitor to sampling mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd Filter conditioning FAILS Contact ECB and PPB before proceeding</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Daily Auto-Precision/Zero/Span Check Data Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Transfer Standard</td>
</tr>
<tr>
<td>0 ppb +/- 2 ppb</td>
</tr>
<tr>
<td>65 ppb +/- 2 ppb</td>
</tr>
<tr>
<td>225 ppb +/- 2 ppb</td>
</tr>
<tr>
<td>Site Ozone Monitor</td>
</tr>
<tr>
<td>Transfer Std +/- 2 ppb</td>
</tr>
<tr>
<td>Transfer Std +/- 3 ppb</td>
</tr>
<tr>
<td>Transfer Std +/- 5 ppb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PASS</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>O3 Monitor and the Transfer Standard PASS Acceptance Criteria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No Additional Action is required and the Precision Point is reported</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FAIL</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>O3 Monitor and/or Transfer Standard FAIL Acceptance criteria</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Site Visit is Required to perform a On-Site Calibration Check</td>
</tr>
</tbody>
</table>
### Site ACTIVITIES (cont.)

#### Ozone Shelter Temperature

The monitoring site is **REQUIRED** to be maintained between 5 - 40° 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° C

**Action** No Action Required

**FAIL** Shelter Temperature is Outside of the 5 - 40° C Range

**Action** The shelter temperature must be immediately adjusted to maintain the site temp between 5 - 40° 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/5 Check Fails to meet Acceptance Criteria. The onsite performance evaluation is performed at the 0 ppb, 65 ppb, and the 225 ppb ozone.

<table>
<thead>
<tr>
<th>On-Site Calibration Check Data Acceptance Criteria</th>
<th>Site Transfer Standard</th>
<th>Site Ozone Monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ppb +/- 2 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
<td></td>
</tr>
<tr>
<td>65 ppb +/- 2 ppb</td>
<td>Transfer Std +/- 2 ppb</td>
<td></td>
</tr>
<tr>
<td>225 ppb +/- 2 ppb</td>
<td>Transfer Std +/- 5 ppb</td>
<td></td>
</tr>
</tbody>
</table>

**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.)

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 \( \geq 65 \) 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.

<table>
<thead>
<tr>
<th>Office Actuated Calibration Check Data Acceptance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Transfer Standard</td>
</tr>
<tr>
<td>0 ppb ( \pm 2 ) ppb</td>
</tr>
<tr>
<td>225 ppb ( \pm 3 ) ppb</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Projects and Procedures Branch</th>
<th>Joette Steger 919-707-8469</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics and Calibration Branch</td>
<td>Derrick House 919-715-1761</td>
</tr>
</tbody>
</table>

Jeff Gobel 919-707-8457
Scott Ginn 919-715-1761
James Olcott 919-715-1761
**FORECAST RULE**

### Air Quality Forecast Rule

<table>
<thead>
<tr>
<th>AQI Forecast Rule</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the AQI Forecast for Ozone in the Region that most closely represents the ozone monitoring site is <strong>Code Yellow AQI &gt; 65</strong>, 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 <strong>Less Than 65</strong>.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Air Quality Forecast Rule Exception</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

### 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.*
# Ozone Monitoring Site Documentation

**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 Activated Cal-Check | Y/N |
| Site Inspection | Y/N |
| Other |  |

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

---

### 1. Site Temperature

- **NIST Temperature** (measure)
- **HOBO Temp.**
- Site Temp. must be 5-40°C for Ozone Data, Calibrations, and Checks to be Valid

**Note:** Check HOBO Temperature before plugging it into computer; it can misread higher temps, once the HOBO is plugged into computer.

**Adjusted Site Temperature to 5 - 40°C**

### 2. Record Ambient Air Ozone Conc. Ppb

- **491 Time:** 8:44
- **NIST:** 8:43
- **DAS Time:** 8:44
- **HOBO** Time: 8:44

**Note:** NIST and DAS Time should be within +/- 1 minute.

- If not, call ECB. If analyzer time is +/-. 2 min. from DAS or NIST Call ECB!

---

### 3. Site Inspection

- **Change in Activities Around Site** (Y/N)
- **Sampling Line, Probe and Funnel intact** (Y/N)
- **Moisture or Debris in Sample Line** (Y/N)

**Detail Site Inspection Exceptions and Site Activities in Comments Section Below**

---

### 4. Thermo 491 Ozone Monitor

- **ID #**
- **Ozone Big Factor**
- **Ozone Coefficient Cal Factor**
- **Alarms Displayed** (Y/N)
- **Which Alarm?**
- **If Alarm is Displayed, contact ECB and PPD Before Proceeding**

- **COO Filter Clean** (Y/N)
## MULTI-POINT CALIBRATION/VERIFICATION

**Section 2.7.2**

**Revision 8.0**

**February 21, 2020**

**Page 76 of 84**

### Date

1/6/1900

### Ozone Monitor Calibration

<table>
<thead>
<tr>
<th>Site</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operator</td>
<td>0</td>
</tr>
<tr>
<td>Ambient Air Ozone ppb</td>
<td>0</td>
</tr>
</tbody>
</table>

### Site Documented Worksheet Must be completed prior to starting the Calibration Procedure

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

### Leak Check (Filter, Conditioning)

<table>
<thead>
<tr>
<th>Filter</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conditioning</td>
<td>0</td>
</tr>
</tbody>
</table>

### Check/Record Spots for $\pm 25$ ppb and Zero and adjust to Acceptable limits as necessary. Then repeat for Zero

<table>
<thead>
<tr>
<th>Level</th>
<th>Reading</th>
<th>Level</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>0.0</td>
<td>4</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Filter Conditioning Evaluation

#### Action

- Check for leaks and recondition the filter once per week or before a new filter and re-run conditioning procedure.

#### Acceptable

- If filter conditioning is acceptable, verify prep and re-run.

### Table for Five-Point Calibration Curve

<table>
<thead>
<tr>
<th>Time</th>
<th>Reading</th>
<th>Time</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>0.0</td>
<td>4</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>0.0</td>
<td>6</td>
<td>0.0</td>
</tr>
</tbody>
</table>

### Calibration Evaluation

#### Acceptable

- For solutions are compared to the theoretical solution.

#### Unacceptable

- If solutions are not comparable to the theoretical solutions, check for leaks and recondition the filter before proceeding.

- If filter conditioning is acceptable, verify prep and re-run.

### Stop Five

- Calibration Factor for Evaluation

#### Acceptable

- Check leak and perform calibration procedure a second time. If second calibration is acceptable, calibration factor is accepted.

#### Unacceptable

- If filter conditioning is unacceptable, recondition.

### Stop Six

- Has the air Ozone Monitor been returned to the Leak Mode?

<table>
<thead>
<tr>
<th>Operator Comments</th>
<th>Regional Camera Review Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Calibration Evaluation

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Site Temp</th>
<th>0</th>
<th>5 - NET Required for Calibration</th>
</tr>
</thead>
</table>
CALIBRATION/VERIFICATION (cont.) and REGRESSION ANALYSIS

Step Seven
Ozone Monitor Calibration Verification and Regression Analysis

Multipoint Verification/Calibration Assessment

<table>
<thead>
<tr>
<th>Calibrator Value (X)</th>
<th>0.00</th>
<th>0.00</th>
<th>0.00</th>
<th>0.00</th>
<th>0.00</th>
<th>0.00</th>
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</thead>
<tbody>
<tr>
<td>Instrument Value (Y)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td></td>
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Average

<table>
<thead>
<tr>
<th>Base Fill Concentration</th>
<th>400</th>
<th>400</th>
<th>400</th>
<th>400</th>
<th>400</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point Difference (Sheet 15 - Average value)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Percent Difference (Cal 1 Conc - Avg Y value)</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
<td>#DIV/0!</td>
</tr>
</tbody>
</table>

- \( r \) slope (m) intercept (b) No reg
- #DIV/0! #DIV/0! #DIV/0! 0.000
- m

CALIBRATION REGRESSION

Slope Intercept Equation:

\[ y = \text{slope} \times x + \text{intercept} \]

Notes: To display slope/intercept values and R² values on the graph—
Insert on Trendline and Error Source buttons and select Format Trendline and check
the bottom two boxes on the Format Operations box.
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 > 55 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.

---

**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**
- New Filter Installed: **Y/N**
- Leak Check Post Filter Change: **Pass**
FILTER CHANGE AND CONDITIONING
PROCEDURE (cont.)

Acceptance Criteria

<table>
<thead>
<tr>
<th>IPS Values are compared to Theoretical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPS</td>
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<tr>
<td>≤2 ppb</td>
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**STEP Four**

<table>
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<th>Level 4 Event 225 ppb</th>
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<tbody>
<tr>
<td>TIME</td>
</tr>
<tr>
<td>Reading</td>
</tr>
<tr>
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**STEP Five**

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<tr>
<td>5</td>
</tr>
<tr>
<td>Avg</td>
</tr>
</tbody>
</table>

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 fall low, a leak at holder or contamination is probable cause.
If filter values fall 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

<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/000</td>
<td>1/000</td>
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</tr>
<tr>
<td>Operator</td>
<td>Critical Steps</td>
<td>Findings</td>
</tr>
<tr>
<td>0</td>
<td>Ambient Air Ozone Concentration</td>
<td>Passed</td>
</tr>
</tbody>
</table>

Filter Conditioning Evaluation
- Site Transfer Standard
- Failed Acceptance Criteria
- Filter Conditioning
- Passed
### ON-SITE MANUAL PERFORMANCE CHECK PROCEDURE

<table>
<thead>
<tr>
<th>Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
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</tr>
<tr>
<td>Operator</td>
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</tr>
<tr>
<td>Initial Site Temperature</td>
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<tr>
<td>Site Temperature Criteria 5-60 °C</td>
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#### Step One

On-Site Calibration Check

**Required Following**
- Failed Daily Auto-Calibration Checks
- Failed Office Activated Calibration Checks

**Site Documentation must be Completed Each Time during Each Site Visit**

**Time** 8:44

**Step Two**

**On-Site Calibration Check**

**Acceptance Criteria**

<table>
<thead>
<tr>
<th>IPS</th>
<th>O3</th>
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</thead>
<tbody>
<tr>
<td>0 ppb ± 2 ppb</td>
<td>≤ IPS ± 2 ppb</td>
</tr>
<tr>
<td>65 ppb ± 2 ppb</td>
<td>≤ IPS ± 3 ppb</td>
</tr>
<tr>
<td>225 ppb ± 2 ppb</td>
<td>≤ IPS ± 5 ppb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zero Event</th>
<th>0 ppb</th>
<th>Level 2 Event</th>
<th>O3 ppb</th>
<th>Level 4 Event</th>
<th>225 ppb</th>
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</thead>
<tbody>
<tr>
<td><strong>Reading</strong> IPS</td>
<td>O3</td>
<td>IPS</td>
<td>O3</td>
<td>IPS</td>
<td>O3</td>
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**Avg** 0.0 0.0 0.0 0.0 0.0 0.0

**Step Three**

**On-Site Calibration Check Evaluation**

<table>
<thead>
<tr>
<th>Site Transfer Standard</th>
<th>Unacceptable Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone Monitor</td>
<td>Acceptable Performance</td>
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</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Ambient Air Ozone Conc.</th>
<th>Performing a particulate filter change is conditional</th>
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<tr>
<td>0</td>
<td>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 $\geq 60$ ppb which will result in a falsely high 8-Hour average ozone concentration and potentially even a false exceedance being reported.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operator Comments</th>
<th>Regional Chemist Review Comments</th>
</tr>
</thead>
<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Date</th>
<th>Site</th>
<th>Site Temp</th>
<th>Site Temp 5-40°C Requirement</th>
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<tr>
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<table>
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<tr>
<th>Critical Steps</th>
<th>Findings</th>
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<tr>
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</tbody>
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On-Site Calibration Check Evaluation

<table>
<thead>
<tr>
<th>Site Transfer Standard</th>
<th>Ozone Monitor</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Passed</td>
<td></td>
</tr>
</tbody>
</table>

Failed Acceptance Criteria
OFFICE ACTUATED MANUAL PERFORMANCE CHECK PROCEDURE

Step One
Purpose for Performing Office Actuated Calibration Check

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

Step Three
Office Actuated Calibration Check
Acceptance Criteria
- IPS Values are compared to Theoretical Values
  - 0 ≤ IPS ≤ 3 ppb
  - 225 ≤ IPS ≤ 5 ppb
- O3 Values are Compared to IPS Values
  - 0 ≤ O3 ≤ 3 ppb
  - 225 ≤ O3 ≤ 5 ppb

<table>
<thead>
<tr>
<th>Zero Event</th>
<th>0 ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>0</td>
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<td>Reading</td>
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<tr>
<td>Avg</td>
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<tr>
<td>Test</td>
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<table>
<thead>
<tr>
<th>Event</th>
<th>225 ppb</th>
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<td>Test</td>
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</tbody>
</table>

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 Region comments

Date 1/000 Site 1/000
Operator 0

Critical Steps Findings
Ozone Concentration 0 Passed

Office Actuated Calibration Check Evaluation
Site Transfer Standard Failed Acceptance Criteria
Ozone Monitor Passed
New: Minutes Data Tab (Example)

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Value</th>
<th>Calib</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/8/2018</td>
<td>9:18 AM</td>
<td>228.7</td>
<td>Calib</td>
<td>224.7</td>
</tr>
<tr>
<td>2/8/2018</td>
<td>9:19 AM</td>
<td>229.1</td>
<td>Calib</td>
<td>224.9</td>
</tr>
<tr>
<td>2/8/2018</td>
<td>9:20 AM</td>
<td>229.4</td>
<td>Calib</td>
<td>225.2</td>
</tr>
<tr>
<td>2/8/2018</td>
<td>9:21 AM</td>
<td>229.5</td>
<td>Calib</td>
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<tr>
<td>2/8/2018</td>
<td>9:22 AM</td>
<td>229.5</td>
<td>Calib</td>
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</tr>
<tr>
<td>2/8/2018</td>
<td>9:23 AM</td>
<td>199.7</td>
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<td>2/8/2018</td>
<td>9:24 AM</td>
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<tr>
<td>2/8/2018</td>
<td>9:25 AM</td>
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</tr>
<tr>
<td>2/8/2018</td>
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