STATEWIDE
STANDARD OPERATING PROCEDURE

FOR

THERMO 49iQ OZONE ANALYZER

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF AIR MONITORING

Prepared by: Florida PQAO Date: December 20, 2023

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Designated Approving Manager

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1.0 PURPOSE

This document has been prepared for Field Technician use during routine, periodic, and calibration visits to ambient air monitoring sites in the Florida air monitoring network utilizing a Thermo Scientific Model 49iQ Ozone Analyzer. This document is not designed to cover all the technical details that are included in the Thermo 49iQ instruction manual, or quality assurance information in 40 Code of Federal Regulations (CFR) Parts 50, 53, and 58; EPA Technical Assistance Documents (TAD's), and related reference materials. Adherence to this Standard Operating Procedure (SOP) will enable the field technician to follow state-wide quality control/quality assurance (QA/QC) requirements. Site field technicians, however, should be knowledgeable of and refer to the references noted in this SOP. Throughout this document, Thermo Model 49iQ-PS and Thermo Model 49iQ refer to the calibrator and analyzer respectively.

2.0 SCOPE AND APPLICABILITY

The Thermo Scientific 49iQ Ozone Analyzer utilizes UV Photometric technology to measure the amount of ozone in the air from ppb levels up to 200 ppm. The instrument is a dual cell photometer, measuring sample and reference gas simultaneously.

This document is intended to be used as a reference for the set-up, calibration, maintenance, and operation of a Thermo Scientific Model 49iQ Ozone Analyzer. The proper utilization of this procedure by the operator, in conjunction with the equipment manufacturer's operation manual (and addendums), will conform to the local, state, and federal data quality objectives, and the air monitoring regulations published in the Code of Federal Regulations (CFR).

3.0 SUMMARY OF THE METHOD

The Model 49iQ is based on the principle that Ozone molecules absorb ultraviolet (UV) light at the wavelength of 254 nm. The degree to which the UV light is absorbed is directly related to the ozone concentration as described by the Beer-Lambert Law.

The ambient air sample is drawn into the Model 49iQ through the sample line and is split into two gas streams. One gas stream flows through an ozone scrubber to become the reference gas. The reference gas then flows to the reference solenoid valve. The sample gas flows directly to the sample solenoid valve. The solenoid valves alternate the reference and sample gas streams between cells A & B every ten seconds. When cell A contains reference gas, cell B contains sample gas and vice versa.

The UV light intensities for each cell are measured by detectors A and B. When the solenoid valve switches the reference and sample gas stream to opposite cells, the light intensities are ignored for several seconds to allow the cells to be flushed. The Model 49iQ calculates the ozone concentration for each cell and outputs the average concentration to the front panel display.

NOTE: The principle of operation employed by the Analyzer to quantify ambient ozone concentrations is described in the Model 49iQ Instruction Manual.

4.0 DEFINITIONS

Technical terms in this SOP are defined as they are introduced so that their meaning is made clear in context. This section explains some general terminology.

A. Calibration – The comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustment.

B. DAS – Data Acquisition System, a data logger interfaced with a software application to collect, store, edit, and report ambient air data.

C. Data Logger – A microprocessor-based electronic device interfaced with ambient air monitors and meteorological sensors to convert analog voltages and digital input to engineering units. These data are stored short-term and retrieved remotely via wireless communications with site specific static IP addresses.

D. Field Technician – Also referred to as the "operator", the individual(s) tasked with properly running and maintaining instrumentation at the site(s). This is a field-based position that relies heavily on proper maintenance tracking and documentation to ensure the equipment is operating properly.

E. 1-Pt QC Check – CFR required comparison of an ozone analyzer's response to a known concentration (70 ppb) performed at a minimum once every 14 days. Technically advanced monitoring sites perform the "precision checks" daily and are used to calculate the random component of error.

F. Calibrator – A microprocessor - controlled ozone generating instrument used to provide known concentrations of ozone to an analyzer. The calibrator remains in a fixed location and is only moved for its annual re-certification against a higher - level standard.

G. Parts per Billion (ppb) – A scientific measurement indicating one part in one billion.

H. Sample Line Integrity Check (SLIC) – The quarterly check done to verify the integrity of the sample line and ensure that the sample line is not having a negative effect on the concentration values read by the analyzer. It is made from a short piece of ¼" Teflon® FEP or equivalent tubing with a Teflon® "T" in the middle for a vent. One end is connected to the output of the Ozone calibrator and the other end to the input of the analyzer.

I. Verification – A check of an instrument reading or system against a field standard whereby no adjustment is made to the analyzer.

J. Zero Air System – A stand-alone system composed of inline scrubbers to remove any contaminants from the air that are used in generating ozone concentrations using the Ozone calibrator. This system can either be a commercially available unit or a unit constructed using a pump/compressor, activated carbon scrubber, and a scrubber with desiccant. The goal is to provide dry, pollutant free zero air.

K. Zero, Span, Precision Check (z/s/p) – The nightly/bi-weekly analyzer check done to establish legally defensible data. This check is also done to bracket periods of valid data and to document analyzer responses before and after any major maintenance/repair activities.

5.0 HEALTH AND SAFETY PRECAUTIONS

CAUTION: Only those trained and authorized shall operate the ozone analyzer and associated equipment.

Electrical Hazards: Equipment used in air monitoring operates on 110/120 volts alternating current (VAC). Site Field Technicians must be very careful to avoid touching (with their hands or tools) live wiring and electrical components. Whenever possible, unplug any equipment being worked on. Some internal components can be damaged by small amounts of static electricity. A properly grounded antistatic wrist strap must be worn while handling any internal component. If an antistatic wrist strap is not available, be sure to touch the instrument chassis before touching any internal components. When the instrument is unplugged, the chassis is not at earth ground.

If the LCD panel breaks, do not let the liquid crystal contact your skin or clothes. If the liquid crystal contacts your skin or clothes, wash immediately using soap and water.

Eye Protection: Ozone analyzers and calibrators use UV lamps. Never look directly at a UV lamp.

Protection from Chemicals: Certain zero air system components as well as certain solvents used can create hazards from breathing or skin contact. Be sure to read and be familiar with Material Safety Data Sheets (MSDS) or Safety Data Sheet (SDS) for any chemicals used. Ozone calibrators generate ozone. Be sure ozone calibrators and analyzers are properly vented to the outside.

Burn Hazards: Certain electrical components within the equipment used for ozone monitoring generate heat. Be knowledgeable of these components and do not touch them.

Mechanical Hazards: Pumps, fans, and other components with moving parts can cause injury. Keep clear of these hazards.

Weather and Natural Hazards: Outdoor work in the field can result in exposure to lightning and other weather hazards. During lightning conditions take cover indoors. Insects (wasps, bees, fire ants, etc.), spiders, snakes, and other animals can create hazards. Be alert when working in the field and avoid these hazards.

6.0 INTERFERENCES

The UV absorption method for detecting ozone is subject to interference from several sources. The possible sources of interference are sulfur dioxide, hydrogen sulfide, nitrogen dioxide, nitric oxide, water, aromatic hydrocarbons such as meta-xylene, styrene and mercury vapor. The basic operating principles of the Thermo 49iQ reject the effect of most of the interferences listed above.

7.0 PERSONNEL QUALIFICATIONS

Personnel who operate instruments used for the ambient monitoring of ozone within the State of Florida are typically selected for their position based on applying for the position and demonstrating they have the required knowledge, skills, and abilities to perform the essential elements of the position. Prior to independently operating ozone monitoring equipment, personnel are to be thoroughly trained in these duties. Supervisory/Management staff will then document they have the required training and will then authorize the employee to perform the operations outlined in this SOP.

8.0 EQUIPMENT AND SUPPLIES

In General, Table 1 lists the recommended tools and supplies for the operation and maintenance of the Thermo 49iQ Ozone Analyzer.

Table 8-1 Standard 49iQ Equipment and Supplies

Category	Components	Thermo Part Number
Diagnostic tools	Hand tools (screwdrivers, wrenches, small sizes, etc.)	*NA
	Temperature transfer standard	NA
	Pressure transfer standard	NA
	Vacuum Tester with Gauge	NA
Consumables	49iQ Consumables Spares Kit	117869-00
Recommended Spare Parts	49iQ Scrubber	117062-00
	Photometer Lamp	116736-00
	Capillary, 1.5” LG, 0.020 bore	4126
Cleaning supplies	Ammonia-based general-purpose cleaner	NA
	Small soft-bristle brush	NA
	Cotton swabs	NA
	Paper towels, soft cloth	NA
	Deionized (DI) water	NA

NA=Not Applicable

9.0 INSTALLATION, START-UP AND OPERATION

9.1. Site Setup

The Thermo 49iQ may be installed within an air monitoring shelter or weather-proof instrument enclosure. In either case, the shelter/enclosure must provide adequate controls to stay within the temperature operating range of 0°C to 45°C. Optimally, the shelter temperature should remain between 20°C to 30°C.

When sitting the inlet system, the Field Technician will locate the sample inlet between 2 and 15 meters above ground level. It is important that the inlet assembly is installed with proper vertical support and secured through the shelter/enclosure at least one (1) meter above the roofline.

The Field Technician will follow the detailed instructions for installation, mounting, and connections provided in the Thermo Scientific Model 49iQ instruction manual.

***CAUTION**: When lifting the instrument, use procedure appropriate to lifting a heavy object, such as, bending at the knees while keeping your back straight and upright. Do not attempt to lift the instrument by the cover or other external fittings.*

***WARNING**: The Model 49iQ is supplied with a three-wire grounding cord. Under no circumstances should this grounding system be defeated.*

9.2. Instrument Setup

Position the 49iQ analyzer on a level and sturdy surface, allowing easy access to both the front and rear panels.

The installation procedure includes connecting the Thermo 49iQ to an ozone calibrator (e.g. Thermo Scientific 49iQ-PS). The ozone calibrator must be certified with an ozone primary standard within the last 365 days to establish traceability back to FDEP (Florida Department of Environmental Protection) Ambient Air Monitoring Standards Laboratory.

Using PTFE Teflon® or equivalent tubing, with an outer diameter (OD) of ¼-inch and a minimum inner diameter (ID) of 3/16-inch, connect a calibration line from the output port at the rear panel of the 49iQ-PS, to the vertical portion of the T-connector of the sampler funnel on the roof. From the horizontal portion of the T-connector of the sampler funnel, using the same Teflon® material and dimensions,

run a sample line to a Teflon® or equivalent filter cartridge and then to the sample inlet port of the 49iQ. Ensure that the sample line is not contaminated by dirty, wet, or incompatible materials. Also perform a residence time calculation. Refer to OAM_TN 21-1 for this procedure.

Plug the analyzer into an outlet of the appropriate voltage and frequency.

***NOTE**: Gas must be delivered to the analyzer at atmospheric pressure. Ensure that the calibration line leaving the ozone calibrator is connected to the T connection that is in-line with the funnel so that the calibration gas is allowed to pass straight through the T and out of the funnel without restriction. This allows the analyzer to sample off the T acting as a manifold.*

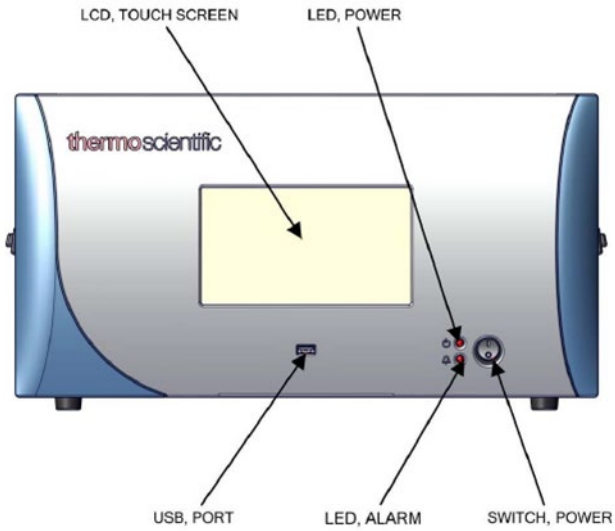
9.3. Startup Procedure

Field Technicians are required to read the manufacturer's instruction manual supplied with the analyzer to become familiar with the analyzer's various controls and components prior to attempting any operation described in this procedure. The manufacturer's manual contains useful analyzer information that has not been repeated in this SOP.

***IMPORTANT**: All startup procedures must be done prior to data collection and must occur at the site where the analyzer will be collecting data.*

***CAUTION**: If the LCD panel breaks, do not let the liquid crystal contact your skin or clothes. If the liquid crystal contacts your skin or clothes, wash it off immediately using soap and water.*

Figure 9-1 Front Panel and Touchscreen Display



Turn the power ON.

Allow the instrument to warm-up and stabilize overnight.

Set instrument parameters such as operating ranges and averaging times to their appropriate settings. See Figures 2 and 3 of the manufacture's manual for Main Menu and Submenu Options for related instrument settings.

1. Verify that the instrument units are parts per billion (ppb) and set the Range to 0-300ppb.

2. Verify that the averaging time is set to 60 seconds.

3. Set the Ozone Calibration factors to 0.0 and the Ozone Coefficient to 1.000.

4. Verify that the Temperature Correction and Pressure Correction parameters are ENABLED.

5. Verify that the cell flow is 0.800L/min-1.600L/min for each cell and Intensities are 45,000-150,000Hz.

6. Set the internal clock to within ±1 min of the site DAS.

Upon installation and annually thereafter, perform a verification of the instrument bench temperature. The internal bench temperature probe is located about ½ inch into the bench and should be verified as accurate by comparison against a certified transfer standard.

7. Remove the instrument cover.

8. Place a NIST traceable temperature standard probe against the aluminum block of the unit near to the internal temperature probe (thermistor) and allow the temperature reading to stabilize, reference Figure 9-3.

9. Compare the temperature reading of the standard probe to the instrument bench temperature reading.

Upon installation and annually thereafter, perform a verification of the instrument pressure sensors. There are two pressure sensors, one measuring the upstream pressure, and one measuring downstream pressure across the capillary. These pressure values are utilized in calculating the sample flow (roughly 1.4L/min combined for both cell A and B) and should be close to ambient pressure. The tubes connected to the pressure sensors will be disconnected one at a time to perform this verification. They are located on the pressure flow DMC board, mounted on the divider panel toward the middle front of the instrument, reference Figure 9-3.

10. Remove the instrument cover.

11. Disconnect the upstream tube connection to allow sensor to read ambient pressure.

12. Allow the pressure standard to stabilize and compare the reading to the instrument pressure reading to a certified pressure standard.

13. If there is a discrepancy, the pressure reading of the 49iQ can be calibrated using the front panel.

14. Repeat these steps for the downstream tube connection.

Before beginning the actual monitoring, perform a multipoint calibration as described in the “Calibration” chapter.

Figure 9-2 Home Screen Display

Figure 9-3 Component Layout Side View

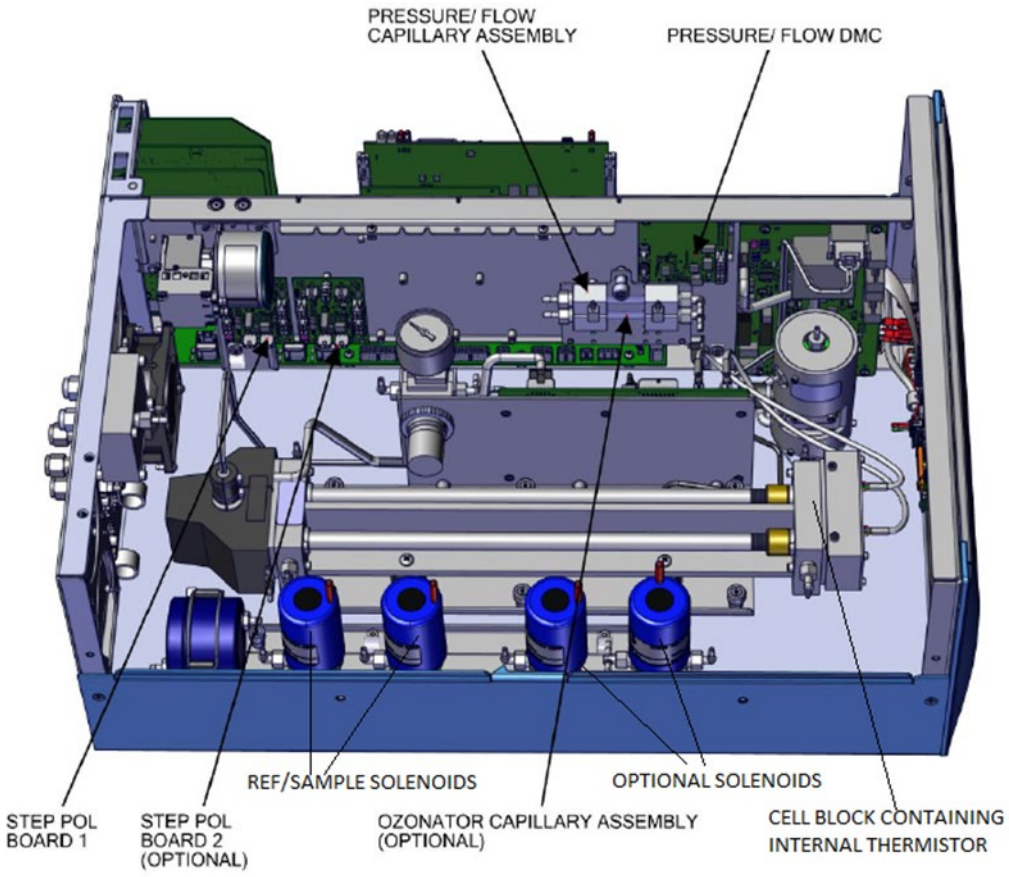
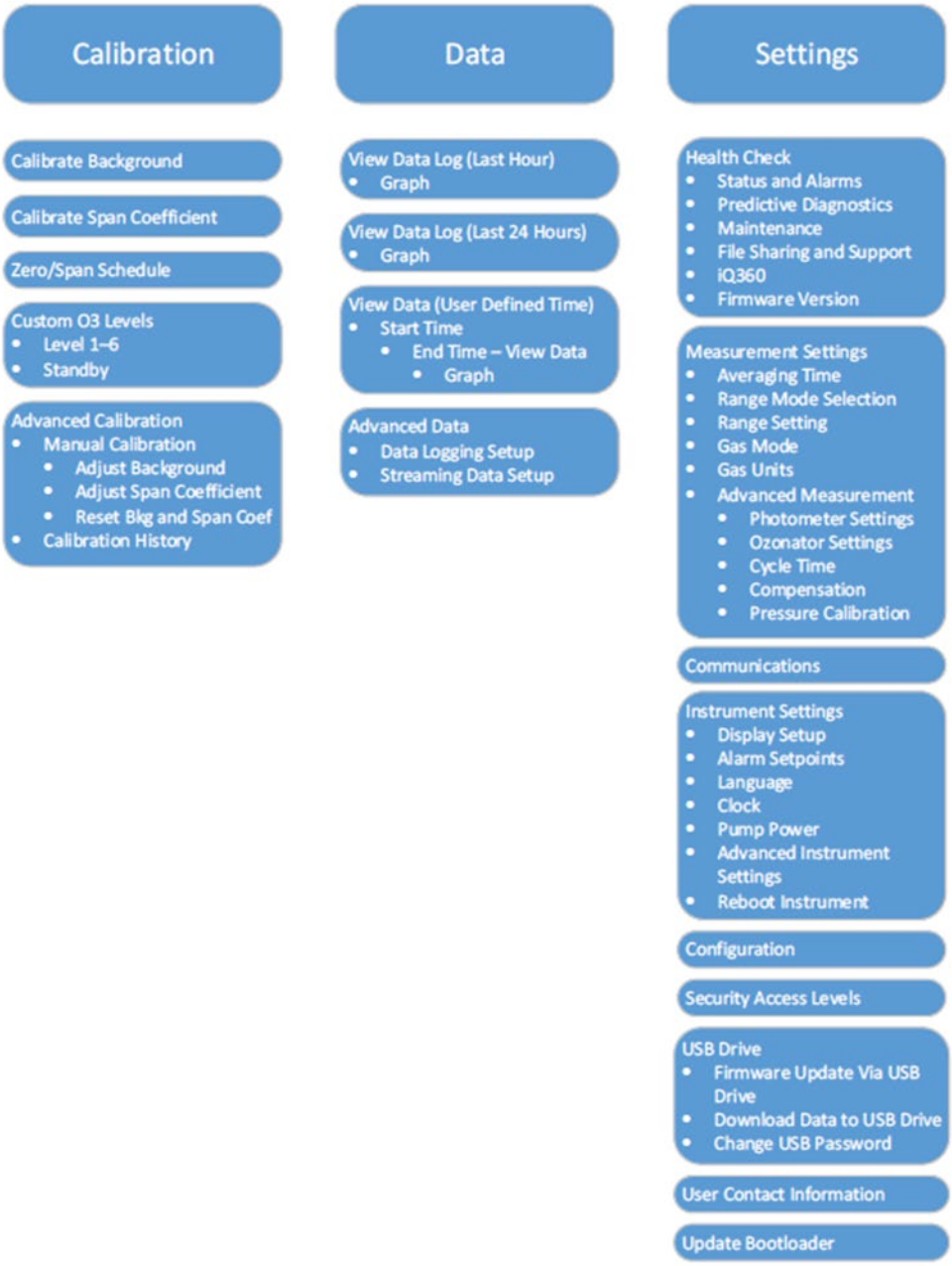


Figure 9-4 Main Menus and Submenus



9.4. Analyzer Removal

This section details the removal of an analyzer that is already installed at a site, such as if the analyzer requires extensive maintenance or replacement. The procedures for reinstalling the analyzer should not be confused with first-time installation procedures. In some instances, the analyzer may need to be removed from the site, such as if it needed total replacement or if a site were to be deactivated. In such an instance, the following procedures should be followed.

NOTE: *For removal/restart before and after a storm, a manual z/s/p must be performed to bracket the ozone data and meet the specifications indicated in Table 12-1. Otherwise, the data may need to be invalidated back to the last good z/s/p. If the analyzer has been removed from the site and/or powered off during a storm for more than 72 hours, a multipoint verification as described in Section 10.1.3 of the SOP* ***MUST*** *be performed before returning to sampling ambient data*.

1. Using the data logger, down the affected analyzer input channel for the long term. Perform a manual zero/span/precision check (Section 12.1) to bracket the data.

2. Note the removal of the analyzer in the "Operator Comments" section on the Thermo 49iQ Equipment Status Report, Form No. DEP 06-18-A, found in APPENDIX A– Forms of this SOP.

3. Turn off the analyzer and unplug the power cord from the 120 VAC outlet.

4. At the rear of the analyzer, disconnect the ¼-inch sample inlet and exhaust tubing.

5. All the pertinent connections to the analyzer should now be disconnected. However, before removing the analyzer, inspect the location to ensure that no physical obstructions are present that could cause problems. Clear any obstructions, then remove the analyzer.

10.0 CALIBRATION

A calibration, in the context of this SOP, refers to the annual check of the ozone analyzer at zero, four upscale points, and a final zero. Depending on the results of the initial zero and span check, the ozone analyzer may or may not be adjusted, in which case the procedure will be referred to as a Calibration or Multipoint Verification, respectively. The calibration procedure is used to document the relationship between the ozone gas concentration measurements made by the analyzer and a recognized ozone gas standard, using an ozone-free gas standard (zero air). The FDEP relies upon this documented relationship to establish the legal traceability of the ambient ozone measurements subsequently made by the analyzer.

All original primary records (those records documenting observations, or other relevant information, which cannot be obtained from another more direct or reliable source) must be dated and signed by the Field Technician and retained as part of the permanent analyzer calibration record. The Field Technician's signature on the calibration form certifies that the calibration has been performed in accordance with this SOP and that the information contained on the form, including any pre-printed entry is accurate. Calibration records must be reviewed and initialed by the agency QA Coordinator or another knowledgeable authority to verify that they are legible and complete.

The analyzer is required to be calibrated prior to its use in collecting ambient ozone data that may be reported to the FDEP's air quality database. The analyzer is normally recalibrated (excluding routine maintenance) under the following conditions:

1. Annually (if automated nightly checks are performed).

2. Semi-Annually (if nightly checks are not automated and only manual bi-weekly checks are performed).

3. Prior to the resumption of ambient data collection following any major maintenance procedure described in the manufacturer's manual and/or addendum. (Refer to Section 11.3 of this SOP for a list of major maintenance procedures).

4. Following a zero response which exceeds ±5.0 (truncated) ppb (if performed bi-weekly) or ±3.0 (truncated) ppb (if performed nightly).

5. Following a span response which exceeds ±7.0 % (truncated) relative difference.

6. Following a precision which exceeds ±7.0 % (truncated) relative difference.

7. Following physical relocation of the analyzer.

8. Following an interruption of power for more than 72 consecutive hours.

NOTE: *Data handling procedures: The Florida QAPP (FDEP Gaseous QAPP) makes validating on the precision results a critical criterion. Before data is invalidated, there should be support of a consistent problem. A precision of greater than 7.0 % (truncated) DOES require investigation. If the precision is out of tolerance, the cause must be identified and corrected. When the precision is out of tolerance, some issues to consider include noise, filter clogging, improper positioning of the sample filters, pump strength, and water or other contaminants in the probe line. The ozone calibrator and ancillary equipment may also be the cause of the non-linear response. If a problem is identified that would affect the validity of the data, that data would be voided. However, if the precision is out, when the zero and span are good, such as with high humidity conditions, and a zero, precision and span check the next day, (or the nightly for a weekend event) provides results within specification, the data would not necessarily be voided, but an appropriate flag should be applied. The cause of the precision drift must be ascertained and rectified as soon as it is possible. Data is invalid if excessive visible liquid phase water is present in any manifold, line, or component in the ambient inlet system.*

In this procedure, the Field Technician uses a calibrator and zero air pack to provide the analyzer with zero air and four known concentrations of ozone over the analyzer's measurement range. This range will include zero, 4 upscale points (250 ppb [span], 120 ppb, 70 ppb [precision], and 40 ppb), and a final zero. All calibration gas must pass through the entire sample train used during normal operation. The analyzer's response to each concentration is recorded and, if necessary, the analyzer is adjusted to accurately measure the ozone gas concentrations. Multiple gas concentrations are used to allow the analyzer's linearity to be assessed. The procedure requires the Field Technician to use the front panel of the calibrator to set the zero, four known ozone concentrations, and final zero to challenge the analyzer.

To ensure the accuracy of the calibration record, the Field Technician must systematically document the calibration process using only approved calibration forms and procedures. All relevant observations or other information must be recorded immediately. The Ozone Calibration Logs must be completed in their entirety, including the heading.

10.1. Equipment Required

Successful calibration of the analyzer requires several important components. DO NOT PROCEED with the calibration procedure unless all these components are on hand:

1. A certified calibrator, a copy of the calibrator's current certification and comparison records, and a copy of the SOP for the calibrator that is to be used.

2. A copy of this SOP and blank copies of all necessary forms. These may be pre-printed hard copies or available electronically.

3. A data logger system with software capable of providing minute data for evaluating instrument stability.

4. A hand-held calculator or equivalent calculation device (e.g., computer software, etc.).

5. A sample line integrity check (SLIC) tubing assembly, which consists of a clean, dedicated 4-6' length of FEP Tubing (Teflon® or equivalent) attached to a Teflon® or equivalent "T."

6. A zero-air system.

10.2. Preparation

Before performing a routine calibration of the analyzer, perform the operational checks (z/s/p) as described in Section 12.1 of this SOP (unless prevented by analyzer malfunction). This data will be recorded on Form No. DEP 06-18-C in the "Z/S/P Check" section, in the "Unadj Zero", "Unadj Span", and "Precision" rows. This form may be found in this SOP in APPENDIX A– Forms.

If the analyzer is being installed for the first time at the monitoring site or re-installed following removal from the monitoring site, the operational checks (z/s/p) do not have to be performed but the Field Technician must complete the following pre-calibration steps:

1. Ensure that the analyzer and calibrator are connected and plumbed as shown in "Plumbing/Wiring Diagram" in Appendix B, section 16.2 of this SOP. Also, ensure that the data logger has been properly wired, initialized, and calibrated in accordance with its respective SOP.

2. Ensure that all steps in Section 9.1.3 of this SOP have been completed and that the analyzer has been allowed to warm up for 2 hours prior to the calibration.

10.3. Step by Step Multipoint Verification/Calibration

***IMPORTANT**: The pre-calibration unadjusted zero and span results are used to assess the need for analyzer adjustment. Failure to perform the z/s/p before adjusting the analyzer zero and/or span may result in the invalidation of ambient ozone data.*

***NOTE**: The SLIC should be performed before the multipoint verification/calibration or after all linearity checks are complete so as not to interrupt the check for the linearity of the analyzer's response curve. See Section 10.1.4 for the SLIC procedure.*

***NOTE**: For steps 1-10 below, a stabilized response is defined as 5 consecutive one-minute readings of ±2 ppb with no upward or downward trend.*

1. Use the DAS or front panel of the calibrator to activate the Zero level and allow the analyzer's response to stabilize for at least 5 minutes prior to recording the values.

2. Record the 10 consecutive and stabilized one-minute readings of the analyzer and calibrator on to the “Data Worksheet” tab of Form DEP 06-18-C, Thermo 49iQ Ozone QC Check and Calibration Log, found in APPENDIX A– Forms. Complete this for the sections labeled “Multipoint Verification/Calibration Data Entry (Calibrator Values)” and “Multipoint Verification/Calibration Data Entry (Analyzer Values)” using the DAS data. If the averaged and stabilized analyzer response is within ±1.5 ppb of zero, the “Result” cell will indicate “PASS” in the Multipoint Verification/Calibration section on the Calibration Log and no adjustment to the analyzer’s zero is required. Skip to number 4 to activate the Span level.

3. If the averaged and stabilized analyzer response is > ±1.5 ppb of zero, the “Result” cell will indicate “CALIBRATE”. Perform a Zero calibration as seen here:

   a. From the Home Screen › Calibration › Adjust Background
   b. Press to set the ozone reading to zero.
   c. Press to return to the Calibration menu.
   d. Press to return to the Run screen.
   e. After all Zero adjustments are completed, wait 10 minutes and then record 10 adjusted, consecutive, and stabilized one-minute readings of the analyzer and calibrator using the DAS data on to the “Data Worksheet” tab of Form DEP 06-18-C. Complete this for the sections labeled “Multipoint Verification/Calibration Data Entry (Calibrator Values)” and “Multipoint Verification/Calibration Data Entry (Analyzer Values)”. Make sure the “Result” cell indicates “PASS” in the Multipoint Verification/ Calibration section on the Calibration Log.

4. Use the DAS or front panel of the calibrator to activate the Span level (250 ppb) and allow the analyzer's response to be stabile for at least 10 minutes.

5. Record the 10 consecutive and stabilized one-minute readings of the analyzer and calibrator on the "Data Worksheet" tab of Form DEP 06-18-C. Complete this for the sections labeled "Multipoint Verification/Calibration Data Entry (Calibrator Values)" and "Multipoint Verification/Calibration Data Entry (Analyzer Values)" using the DAS data. If the averaged and stabilized analyzer response is within ±2.0% of the calibrator response at Span, the "Result" cell will indicate "PASS" in the Multipoint Verification/ Calibration section on the Calibration Log and no adjustment is required. Skip to number 7. The Mid-Point, Precision, and Low Points tolerances will be determined by the Linearity Check.

Manual Calculation of the Span level:

If the Excel version of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log is not used, the quality control calculations must be done manually. This is done by comparing the averaged analyzer response with the averaged calibrator response at the unadjusted/adjusted Span calibration point by using the following formula:

Equation 10-1 Percent Difference

$$\frac{[\text{AA ozone concentration} - \text{AC ozone concentration}]}{\text{AC ozone concentration}} \times 100$$

Where: AA = Averaged Analyzer Response
AC = Averaged Calibrator Response

6. If the averaged and stabilized analyzer response is > ±2.0 % of the calibrator response (except the points where the Linearity Check applies), the "Result" cell will indicate "CALIBRATE". Perform a Span calibration as seen here:

   a. From the Home Screen › Calibration › Advanced Calibration › Manual Calibration › Adjust Span Coefficient.

   b. After all Span adjustments are completed, wait 10 minutes and record 10 adjusted, consecutive, and stabilized one-minute readings of the analyzer and calibrator using the DAS data on to the "Data Worksheet" tab of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log, found in APPENDIX A– Forms. Complete this for the sections labeled "Multipoint Verification/Calibration Data Entry (Calibrator Values)" and "Multipoint Verification/Calibration Data Entry (Analyzer Values)". Make sure the "Result" cell indicates "PASS" at all points in the Multipoint Verification/Calibration section on the Calibration Log.

7. Use the data logger or front panel to repeat Steps 1 and 2 for the upscale points of 120 ppb, 70 ppb, and 40 ppb.

NOTE: *Do not attempt to calibrate (adjust) the analyzer at the precision, mid, or low points. The analyzer is only calibrated at the zero and span points. All other points are run to check the linearity of the analyzer.*

8. A final zero event must be run to ensure the analyzer has not experienced any shift in the Zero concentrations by following Step 1 above. Any cells not filled in on Form DEP 06-13-C should be filled in with "N/A". Use the data logger or calibrator to deactivate all calibration activities and return the analyzer to the ambient data collection following approximately 5 minutes.

NOTE*: Multipoint Verification and/or Calibration data is validated using a linearity check whereby all points (Analyzer response versus Calibrator concentration) must be < ±2.1 % or ≤ ±1.5 ppb difference of a best-fit straight line, whichever is greater, and Slope 1 ±0.05. These calculations and all averages from the above steps are performed automatically on the electronic version of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log in the "Linearity Check" and "Multipoint Verification/Calibration" sections, respectively.*

10.4. Sample Line Integrity Check (SLIC)

In this procedure, the Field Technician must determine if contamination of the sample line is adversely affecting ambient ozone measurements made by the analyzer. This check is required to be performed during each regularly scheduled analyzer calibration/verification, once per quarter, and whenever visible moisture is observed in the sample line or sample line filter. It may also be performed at any time the Field Technician suspects the sample line has become contaminated. If the sample lines are contaminated, the entire sample line must be changed. Note that the SLIC should be performed before a multipoint verification/calibration.

Some agencies have safety protocols in place that determine whether to leave the span gas running during the line changes, or to turn off gas generation and/or flow from the calibrator so that only dilution (zero) air is running during the line changes. Consult with your QA coordinator to identify the procedure ("zero/span/zero" or "span only") used within your network.

NOTE: *SLICs performed as part of the annual calibration procedure are documented in the row labeled SLIC on Form DEP-06-18-C. SLICs performed as part of the quarterly preventative maintenance are documented in the appropriate column on Form DEP-06-18-B. SLIC results obtained for any other reason (such as troubleshooting) should be properly documented within the comments section of the applicable form. When asked for an averaged analyzer response after a stable response is achieved, use the average of five consecutive 1-minute readings from the Data Logger to calculate the averaged data response*.

1. Do not adjust any of the settings in the analyzer. Disconnect the calibrator Ozone line and the analyzer Sample line at the rear of the instrument.

2. Attach one end of the SLIC line to the calibrator Ozone port and attach the other end to a Teflon® "T." From the "T" connect two lines: one to the Sample port of the analyzer, and the other continuing straight to a suitable exhaust manifold or other exterior vent.

3. After the SLIC tubing has been installed, allow the analyzer's response to the 250 ppb output concentration to stabilize. Record the five 1-minute averages from the analyzer on the Data Worksheet tab of Form DEP 06-18-C.

4. Equation 2 below is used to calculate the relative percent difference between the analyzer response through its normal sample line and through the clean SLIC line:

Equation 10-2 SLIC Calculation

$$\%DIFF = \frac{[\text{Response (PPB)through sample line-Response (PPB) through SLIC line}]}{\text{Response (PPB) through SLIC line}} \times 100$$

***NOTE**: This value will be calculated automatically on the form.*

5. If the calculated difference is ≤ 2.0 %, truncated to one decimal place, the analyzer's sample line is approved for further use. "PASS" will be indicated under the "RESULT" column. Disconnect the SLIC line from the calibrator, analyzer, and vent. Re-install the original sample line.

6. If the calculated difference is > 2.0 %, "FAIL" will be indicated under the "RESULT" column. The analyzer's sample line must be investigated, cleaned, or replaced before proceeding with the analyzer calibration or resuming ambient data collection. Begin by troubleshooting for any leaks or loose connections in the sample train and then recheck the sample line until the calculated results are within ≤ 2.0 %. Record the sample line service in the appropriate column of Form DEP 06-18-B, Thermo 49iQ Preventative Maintenance Log.

10.5. Post Maintenance Check

A Post Maintenance check (z/s or z/s/p) must be run before resuming ambient data collection by following the steps in Section 12.3.

11.0 INSTRUMENT MAINTENANCE

All maintenance of the TEI 49iQ falls into two primary categories: preventive and corrective. Preventive maintenance is used to reduce the likelihood of future equipment failure, while corrective maintenance is used to return malfunctioning equipment to a fully operational or repaired state.

NOTE: *All* ***preventive*** *maintenance activities* ***must*** *be preceded by a bracketing z/s/p check and followed by either z/s/p or z/s checks to ensure that the analyzer is producing the highest quality data and that the maintenance activities did not cause the analyzer to run in an unacceptable condition. Document the z/s/p checks on Form DEP 06-18-C. If this is not done, it may be necessary to invalidate data going back to the last acceptable z/s/p check.*

11.1. Preventive Maintenance

This section describes the periodic maintenance that must be performed on the Model 49iQ to ensure proper and uninterrupted operation. Prior to performing any scheduled preventive maintenance, the Field Technician must first place the affected channel in the data logger into "Maintenance" mode or down the channel. After successful completion, document the maintenance on the Preventative Maintenance Log, Form DEP-06-18-B. Check the specified frequency for each maintenance procedure to determine the next due date for each procedure performed. Below is a list of the preventive maintenance requirements, along with step-by-step procedures.

11.1.1. Clean Instrument Interior, (Includes Cooling Fan, and Screen Cleaning)

Lint and dirt can accumulate inside the analyzer even under the cleanest conditions. If left unchecked, dirt can eventually degrade analyzer performance and possibly cause instrument failure. For this reason, the analyzer must be cleaned quarterly.

1. Ensure the appropriate channel in the data logger is placed into "Maintenance" mode or offline, then turn the analyzer off and disconnect the power cord from the 120 VAC outlet.

2. Remove the fan filter cover by gently pulling it off the fan guard and remove the filter. Clean the fan filter. Reinstall the filter and filter cover.

3. Expose the analyzer's interior by removing the top access cover.

4. Clean dust from the cooling fan.

5. Reinstall the analyzer's top cover. Plug the 120 VAC power cord into the outlet and turn the analyzer on.

6. Once the analyzer has stabilized (approximately 10 minutes), remove the affected data logger channel from "Maintenance" mode or up the channel.

11.1.2. Clean Absorption Cells

Contamination may enter the absorption cells of the photometer bench despite the use of sample line filters in the system. Any contamination in this area will lead to interference with the ozone measurement and may yield inaccurate data. It is for this reason that the absorption cells of the photometer bench should be cleaned and inspected on an annual basis.

1. Ensure the appropriate channel in the data logger is placed into "Maintenance" mode or offline, then turn the analyzer off and disconnect the power cord from the 120 VAC outlet.

2. Remove the lid from the analyzer.

3. Locate Cell A and Cell B. Unscrew the knurled nut to free the absorption cell from the bench.

4. Hold the absorption cell up towards a light and look down the length of the tube for any contamination. Small specks of dirt may be visible along the liner of the tube.

5. Using compressed air or a KimWipe®, remove any contamination.

6. Reinstall the cleaned absorption cells.

11.1.3. Change Sample Line Filter

The sample line filter contains a PTFE or Teflon® element that must be inspected monthly and replaced quarterly. The agency can choose to replace it more often.

1. Ensure the appropriate channel in the data logger is placed into "Maintenance" mode or offline. Turning the analyzer or the pump off ensures that no particles will be drawn into the analyzer.

2. Open the filter holder using the provided filter holder wrench. Once the ends of the holder have been separated remove and discard the filter element.

***NOTE**: When installing the new filter membrane into the filter holder, ensure that it lies flat against, and completely covers, the perforated surface at the output end of the holder. If the membrane is wrinkled or does not cover all the perforation holes, the filter will leak and could cause equipment damage and possible sample contamination.*

3. Once the filter membrane is in place, grasp both ends of the filter holder and re-thread then tighten the two ends together.

4. Before completing the maintenance, you should first condition the filter membrane by saturating it with a high concentration of ozone gas. The filter is saturated when the ozone concentration reading reaches the set value.

5. Perform a follow up zero and span check to verify the operational status. If the check is outside allowable limits, re-enter maintenance mode to trouble shoot the possible cause.

11.1.4. Temperature and Pressure Certification

This is an annual maintenance requirement. It is to be documented on Form No. DEP 06-18-D. Also document the occurrence in the Preventative Maintenance Log Form No. DEP 06-18-B. The analyzer has two pressure readings. They are used to calculate the analyzer flow.

A. Pressure Certification:

1. Use a flow standard to measure the sample flow on the Sample In port. Record this reading in the As Found Flow Verification/Calibration on Form 06-18-D. Then remove the cover of the unit. From the Main Menu press Settings, Measurement Settings, Advanced Measurement Settings, Pressure Calibration.

2. Inside the unit locate Pressure Sensor 1 and remove the hose from the DMC board pressure sensor.

3. Wait for the Sensor 1 reading to go to zero and place the pressure transfer standard near the open case of the unit. On Form 06-18-D record the ambient readings for Sensor 1 and the transfer standard pressure reading. If the two readings are within 5 mmHg then no calibration is required. If they need calibrating follow Step 4.

4. To calibrate Sensor 1 find Atmospheric Sensor 1 in that same menu. Press that number in the Reading Column. Then input the transfer standard reading and press the Enter button. Then press the Start button in the Calibration column. This will calibrate the Sensor 1 reading to match the pressure standard.

5. Re-attach the hose to the pressure onboard pressure sensor.

6. Repeat Steps 2-5 for Sensor 2 and record those readings on Form DEP 06-18-D. If a pressure adjustment was made, measure the sample flow and record the readings as the Post Calibration flow check.

B. Temperature Comparison:

1. Remove the cover of the unit. Locate the photometer bench temperature sensor.

2. Remove the hex screw in the bench right above the temp sensor with a hex key.

Insert a temperature transfer standard temp probe into the hole. Allow enough time for the transfer standard to acclimate to the bench temperature and record both readings on Form DEP 06-18-D. If the readings are more than 2 degrees different contact Thermo for further technical support, or a new temp sensor. **(Note: The Bench Temperature cannot be calibrated.)**

11.1.5. Clean/Replace Sample Lines

To ensure that accurate samples are being transmitted from the inlet manifold to the analyzer, it is essential that the sample lines be kept clear of any obstructions and free of possible.

contaminants. To ensure sample line integrity, these sample lines need to be cleaned or replaced annually (not more than 365 days) or if a contaminant is detected during a z/s/p check or quarterly SLIC.

1. Ensure the appropriate channel in the data logger is placed into "Maintenance" mode or offline. Detach all the sample lines and filter holder from the inlet to the back of the analyzer, including the sample inlet funnel and the lines leading to the back of the calibrator.

2. Remove the filter membrane from the filter holder using the same method listed in Section 11.1.3 above.

3. Replace the sample lines going to the calibrator and analyzer, and then re-install the sample line filter assembly.

4. Using the procedure in Section 11.1.3 above, replace the sample filter membrane into the sample filter holder.

5. Condition the sample line and filter with proportional amount of ozone.

6. Perform at a minimum, a z/s check to verify the operational status of the analyzer.

Note: *After cleaning or replacing the sample lines perform a residence time measurement. Use reference document OAM_TN 21-1 to calculate residence time on the appropriate form.*

11.2. Corrective Maintenance

This section describes the maintenance that must be performed on the Model 49iQ when it is discovered that some error with the analyzer is negatively affecting data quality. Prior to performing any corrective maintenance, the Field Technician must first place the affected channel in the data logger into "Maintenance" mode. After successful completion, document the maintenance on the Preventative Maintenance Log, Form DEP-06-18-B in the "Operator Comments" section. The Field Technician's first initial and last name as well as the date of the maintenance must also be recorded with this information. Below is a list of the corrective maintenance items, along with step-by-step procedures.

***NOTE**: All corrective maintenance activities must be preceded by a bracketing z/s/p and followed by either z/s/p or z/s checks where possible to ensure that the analyzer is producing the highest quality data and that the maintenance activities did not cause the analyzer to run in an unacceptable condition. Document the z/s/p checks on Form DEP 06-13-C. If this is not done, it may be necessary to invalidate data going back to the last acceptable z/s/p check.*

11.2.1. System Leak Check

Use the following procedure to check for system leaks. This procedure should be used in situations to troubleshoot unstable zero values and noise at higher concentrations.

Equipment required:

- • Cap
- • Vacuum tester with gauge (resolution .5 in Hg or better)

1. Turn the instrument off, unplug the power cord.
2. Block the SAMPLE bulkhead on the rear panel with a leak-tight cap.
3. Connect the vacuum tester tool to the EXAUST bulkhead on the rear panel.
4. Squeeze the trigger until the gauge reads to pull in 10 inches Hg.
5. Observe vacuum gauge for stable reading for 5 minutes. If the gauge remains at 10 inches Hg, no leak is present.

***Note**: Acceptable leak rate is .5 in Hg over 10 minutes*.

11.2.2. Inspect/Replace Capillaries

The flow reducing capillaries control the flow rate through the pneumatic system of the 49iQ and should operate with little or no need for servicing throughout the life of the instrument. However, in cases when the sample flow through one or both cells has diminished below 0.400 L/min, the capillaries may be clogged and need servicing or replacement. The following procedure can be used in such a case.

Equipment Required:

- • Phillip’s drive, #2
- • Hex Drive, 7/64

1. Turn the instrument off, unplug the power cord, and remove the cover.
2. Disconnect the plumbing.
3. Using #2 Phillip’s drive, unfasten captive hardware.
4. Slide the capillary plate upwards, clearing the partition panel keyway.
5. Using the 7/64 hex drive, remove the 4 socket cap head screws.
6. Pull apart the capillary blocks.
7. Remove the capillaries and clean or replace.
8. Replace capillaries and reassemble in reverse order.

11.2.3. Photometer Lamp Adjustment

The Photometer Lamp will occasionally need adjustment. Check the Intensities for A & B annually and record them in form 06-18-D. A lamp adjustment may be performed when there is a noticeable degradation in the light output from the Photometer Lamp. In normal usage the lamp may form dark spots or imperfections in the surface of the lamp that degrade the lamp’s intensity at these points. Reorienting the lamp mitigates the appearance of “bad spots”, thus increasing the intensity at the cell detectors. This reorientation is accomplished by the following procedure:

1. From the Home Screen, press “Settings” → “Health Check” → “Status and Alarms” → “Photometer Bench”.

2. Use the arrow down button to display both the Cell A and Cell B Intensities.

3. Locate the Photometer Lamp as seen in Figure 7-37 of the Thermo 49iQ Instrument Manual.

4. Peel back the black foam insulation at the base of the bulb to expose the screw that secures the bulb in place. Loosen the screw but do not unscrew it all the way.

5. While viewing the intensities for Cell A and B as seen in Step B above, carefully turn the Photometer Lamp until the maximum intensities are displayed.

6. When adjusting the lamp to get the highest intensities, do not try to balance the intensities to make them match as this will misadjust the lamp.

7. Adjust the intensities to approximately 100000 Hz in each cell on average or an average of 100000 Hz between the cells.

8. If unable to achieve the desired intensity levels, the photometer lamp may need to be replaced. See page 7-30 of the Thermo 49iQ Instruction Manual for the step-by-step procedure to replace the Photometer Lamp.

11.3. Major Maintenance

This section lists the varying analyzer major maintenance items which require that a multipoint calibration be performed upon their completion. The necessity results from the possible effect these procedures might have on the response of the analyzer. Refer to Section 10.0 for calibration instructions.

11.3.1. Types of Major Maintenance

Field Technicians may reference the manufacturer’s Instruction Manual for directions on performing these procedures. Thermo Technical Support may also be contacted at 1-508-520-0430 for further information.

1. Bench Detector Replacement (one or both detectors)
2. Solenoid Replacement (one or both solenoids)
3. Ozone Scrubber Replacement
4. Pressure Transducer Replacement
5. Bench Temperature Sensor Replacement
6. Processor Board Replacement
7. Power Supply Board Replacement
8. Pump Rebuilding
9. Disassembly and Removal of the Bench (not including Cell Removal and Lamp Replacement)
10. Calibrator Replacement

12.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance is a system of management and operational activities designed to ensure that the data produced by the operation of the 49iQ will be of the type and quality needed and expected by the data user. Quality control defines the procedures implemented to assure that acceptable precision, bias, completeness, representativeness, and comparability are obtained and maintained in the generated data set. Quality control procedures, when properly executed, provide data that meet or exceed the minimally acceptable quality criteria established to assist management in making confident decisions. It is the policy of the department to implement a QA program and QC procedures to assure that data of known and acceptable precision, bias, completeness, comparability, and representativeness are collected from all monitoring projects. The procedures and their associated intervals used to manage the quality of data generated by the Thermo 49iQ are outlined in Table 12-1.

12.1. Precision Checks

The validity and/or repeatability of the ambient ozone data obtained from the analyzer are primarily determined from the results of precision checks (1-Pt QC Checks). A z/s/p check will be talked about in this section. It is important, therefore, to define it: A zero, span and precision (z/s/p) check is the primary quality control data validation activity. This term is used interchangeably with "Precision Check" and "1-Pt QC Check" throughout this SOP. A z/s/p check is run against the analyzer in an "as is" condition using the same calibration system and same calibration gases used to originally calibrate the analyzer. This check brackets those data produced since the last valid z/s/p check. The specific concentration levels to be used for Span and Precision will be 250 ppb and 70 ppb, respectively. Specific result limits and related activities are specified in the Florida QAPP's and Table 12-1 of this SOP. The z/s/p check may be performed using either a manual or automated system. To meet the minimum data validation requirements, a z/s/p check must be run at a minimum of once every 14 days. This requirement is met at sites running automated nightly checks. In the event the calibrator breaks down, the z/s/p event must be run bi-weekly and recorded in Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log.

Warning Limit: Precision check results with a percent difference $\geq \pm 5.0$ % should initiate investigative action to ensure the validity of the data. Action(s) taken should be documented accordingly.

During the z/s/p check, the analyzer must sample the output from the Ozone calibrator through the ambient sampling line that is used during normal operation. This interconnecting ambient sampling line includes the sample line and filter attached in series. The two sample lines each connecting the analyzer and the calibrator respectively, are passed through to a sample "T" at the inlet and vented to

the ambient air (See the diagram for the Sample Line Configuration in 16.2). The ozone generated from the calibrator, during the nightly automatic or scheduled calibration, is sampled through the sample intake line connected to the analyzer.

***IMPORTANT**: Automated or manual z/s/p checks that do not conform to these requirements may not be used to calculate analyzer precision or determine compliance with applicable data validation control limits. Operational checks are not to be the sole event in determining data validation.*

In addition to a minimum of once every 14 days, a z/s/p check must be performed in the following situations:

1. Immediately prior to a multipoint calibration of the analyzer unless prevented by its malfunction.

***NOTE**: This check is not required prior to the calibration performed following the analyzer's initial installation (or re-installation) at the monitoring site.*

2. Immediately prior to an intentional analyzer shutdown (e.g. hurricane, end of site operations etc.) likely to last longer than seventy-two (72) hours, unless prevented by its malfunction.

3. Immediately prior to performing any of the "major" maintenance procedures for analyzer described in the manufacturer's manual and/or addendum, unless prevented by its malfunction. (Refer to Section 11.3 for a list of major maintenance procedures).

4. Prior to any other operation which is likely to affect the response of the analyzer (e.g., sample line cleaning or drying, sample filter replacement, voltage adjustment), unless prevented by its malfunction.

All z/s/p checks are recorded on Form DEP-06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log in the "Z/S/P Check" section. The results of each z/s/p check must be included in the applicable quality control reports associated with the analyzer upon installation of the complete system.

Table 12-1 QA/QC Schedule

Procedure	Description		Frequency
Z/S/P Check	Zero Drift: Acceptable- No Action Required		Once every 14 days (or nightly)
	Once Every 14 Days	<±5.1 ppb Difference	
	Nightly	<±3.1 ppb Difference	
	Span Check (250 ppb):		
	Once every 14 days	<±7.1 % Difference	
	Nightly	<±7.1 % Difference	
	Precision Check (70 ppb):		
	Once Every 14 Days	<±7.1 % Difference	
	Nightly	<±7.1 % Difference	
	Data Validation: Acceptance Limits		
	1-Pt QC Check (70 ppb)	<±7.1 % Difference Note: Warning Limit >±5%	
S.L.I.C. Test	Difference between sample line response and SLIC line response ≤±2.0%		Quarterly
Shelter Temp Sensor	Check ambient temperature against a NIST traceable standard. Note: the allowable shelter temperature range is 0°C to 45°C		Bi-Annually
Pressure Sensor	Check the 49iQ pressure sensor reading against a NIST traceable standard		Annually
Temp Sensor	Check the 49iQ bench temperature sensor of the analyzer against a NIST traceable standard		Annually
Time Clock	Check analyzer time clock against a chronometer standard (i.e., NIST time at 303-499-7111)		Monthly
Sample Line Filter	Inspect the Teflon® sample line filter. Replace the Teflon® sample line filter		Monthly Quarterly
Multipoint Calibration	An analyzer check at zero and 4 upscale points if automated nightly checks are performed.		Annually
Multipoint Calibration	An analyzer check at zero and 4 upscale points if NO automated nightly checks are performed and only manual bi-weekly z/s/p checks are done.		Semi-Annually
Clean/Replace Sample Lines	Clean and/or replace the sample lines		Annually
DEP Performance Audit	Comparison of the analyzer response to a Florida DEP Transfer Standard		Annually

12.1.1. Equipment Required

A complete list of the equipment required to complete the z/s/p checks of the analyzer is provided in Section 10.1 of this SOP. In addition to these items, a blank copy of Form 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log, is needed. DO NOT PROCEED with the operational check procedure unless each of the required components is on hand.

***NOTE**: The SLIC tubing assembly listed in Section 10.1 is not required to complete these operational checks. However, it is required on a quarterly basis and when the annual multipoint calibration check is performed.*

12.1.2. Automated Nightly Procedure Using the Data Logger

With the analyzer installed in accordance with the standard Florida PQAO configuration (see Section 16.2), the system can perform a nightly automated z/s/p check. The gas concentration levels set in the Ozone calibrator for the nightly check are identical to the levels used during any routine z/s/p check. See the associated SOP for the Ozone calibrator being used for configuration of the automated nightly check concentration levels. The SOP for the data logger system will also be used in configuring the automated nightly checks.

***NOTE**: If using automated nightly z/s/p checks, a failed automated check must be immediately followed by a manual z/s/p check to verify the correct operation of the analyzer. This will minimize data loss and ensure the highest level of data quality.*

12.1.3. Manual Procedure Using the Data Logger

In this procedure, the Field Technician will first supply the analyzer with zero air, then an ozone concentration of around 250 ppb (Span) and, finally, with a concentration of 70 ppb (Precision).

***IMPORTANT**: The Field Technician must allow the analyzer response to stabilize after it begins sampling gas concentrations from the calibrator.*

***NOTE**: Stability is determined when 5 consecutive one-minute readings are within ±2 ppb of each other with no upward or downward trend.*

1. Complete the “Site Identification Block” of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log.

2. Use the DAS or front panel of the calibrator to activate the Zero level and allow the analyzer's response to stabilize for at least 10 minutes. Record the 5 consecutive and stabilized one-minute readings of the analyzer and calibrator on to the “Data Worksheet” tab of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log, found in APPENDIX A– Forms. Complete this for the sections labeled “Z/S/P Check (Calibrator Values)” and “Z/S/P Check (Analyzer Values)” using the DAS data. If the averaged and stabilized analyzer response is within ±3 ppb of zero (±5.0 ppb for checks performed once every 14 days), the “Result” cell will indicate “PASS” in the z/s/p check section on the Calibration Log and no adjustment to the analyzer’s zero is required. Skip to 4 to activate the Span level.

3. If averaged and stabilized analyzer response is exceeded (indicated by “CALIBRATE” in the “Result” cell), complete the entire z/s/p check, but do not resume ambient sampling or perform a calibration until the cause of the lack of concurrence is identified and corrected.

IMPORTANT: *If the % difference calculated in step 2 is > ±3.0 ppb (> ±5.0 ppb for checks performed once every 14 days), an adjusted multipoint calibration is required after investigation and prior to resuming ambient ozone data collection. Additionally, the ambient ozone data collected by the analyzer since the most recent passing z/s/p check may be invalid. Notify the agency QA Coordinator of the results and conduct a fully documented investigation of all factors which may have caused the poor Zero check result. The investigation should review the operational technique used during the Zero check, the status of the calibrator, as well as the condition of each component of the analyzer's sample line. If no problem is found with the calibration system or the operational technique used to perform the Zero check, the suspect data must be withheld or, if already reported, removed from the Florida database.*

4. Use the DAS or front panel of the calibrator to activate the Span level (250 ppb) and allow the analyzer's response to stabilize for at least 10 minutes. Record the 5 consecutive and stabilized one-minute readings of the analyzer and calibrator on to the “Data Worksheet” tab of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log, found in APPENDIX A– Forms. Complete this for the sections labeled “Z/S/P Check (Calibrator Values)” and “Z/S/P Check (Analyzer Values)” using the DAS data. If the averaged and stabilized analyzer response is within ±7.0 % of the calibrator response, the “Result” cell will indicate “PASS” in the z/s/p check section on the Calibration Log and no adjustment is required. Skip to 6 to activate the Precision level.

5. If the averaged and stabilized analyzer response is exceeded (indicated by “CALIBRATE” in the “Result” cell), complete the entire z/s/p check, but do not resume ambient sampling or perform a calibration until the cause of the lack of concurrence is identified and corrected.

IMPORTANT*: If the % difference calculated in step D is > ±7.0 %, an adjusted multipoint calibration is required after investigation and prior to resuming ambient ozone data collection. Additionally, the ambient ozone data collected by the analyzer since the most recent passing z/s/p check may be invalid. Notify the agency QA Coordinator of the results and conduct a fully documented investigation of all factors which may have caused the poor Span result. The investigation should review the operational technique used during the Span check, the status of the calibrator, as well as the condition of each component of the analyzer's sample line. If no problem is found with the calibration system or the operational technique used to perform the Span check, the suspect data must be withheld or, if already reported, removed from the Florida database.*

6. Use the DAS or front panel of the calibrator to activate the Precision level (70 ppb) and allow the analyzer's response to stabilize for at least 10 minutes. Record the 5 consecutive and stabilized one-minute readings of the analyzer and calibrator on to the “Data Worksheet” tab of Form DEP 06-18-C, Thermo Model 49iQ Ozone QC Check and Calibration Log, found in

APPENDIX A– Forms. Complete this for the sections labeled “Z/S/P Check (Calibrator Values)” and “Z/S/P Check (Analyzer Values)” using the DAS data. If the averaged and stabilized analyzer response is within ±7.0 % of the calibrator response, the “Result” cell will indicate “PASS” in the z/s/p check section on the Calibration Log and no adjustment is required.

7. If the averaged and stabilized analyzer response is exceeded (indicated by “CALIBRATE” in the “Result” cell), complete the entire z/s/p check, but do not resume ambient sampling or perform a calibration until the cause of the lack of concurrence is identified and corrected.

IMPORTANT *If the % difference calculated in step F is > ±7.0 %, an adjusted multipoint calibration is required after investigation and prior to resuming ambient ozone data collection. Additionally, the ambient ozone data collected by the analyzer since the most recent passing z/s/p check may be invalid. Notify the agency QA Coordinator of the results and conduct a fully documented investigation of all factors which may have caused the poor Precision result. The investigation should review the operational technique used during the Precision check, the status of the calibrator, as well as the condition of each component of the analyzer's sample line. If no problem is found with the calibration system or the operational technique used to perform the Precision check, the suspect data must be withheld or, if already reported, removed from the Florida database.*

8. If maintenance is done after the manual z/s/p check, a Post Maintenance check (z/s or z/s/p) must be run before resuming ambient data collection by following the steps in Section 12.1.4. above. The readings from this check will be completed for the sections labeled “Post Maintenance Z/S/P Check (Calibrator Values)” and “Post Maintenance Z/S/P Check (Analyzer Values)” using the DAS data. Make sure the “Result” cells indicate “PASS” in the Post Maintenance Check section on the Calibration Log before resuming ambient data collection. Any cells not filled in on Form DEP 06-18-C should be filled in with “N/A”. Use the data logger (or primary standard front panel controls) to deactivate all events and return the analyzer to the ambient data collection mode. A minimum of five minutes must pass before re-enabling the Ozone data channels in the data logger.

12.2. Routine Checks

Routine checks are performed to establish or confirm the status of the ambient ozone monitoring system. The results of these checks, when properly and systematically documented, may be used to determine the reliability of the data produced by the analyzer monitoring system. The Field Technician observations compiled in these records are indispensable in identifying equipment problems which may adversely affect the ability of the equipment to properly measure ambient ozone concentrations. This procedure contains several steps in which indicators of unusual equipment status require the Field Technician to perform manual z/s/p checks. The results of these checks are then used to determine the effect of the unusual equipment status on the measurements made by the analyzer

and thus determine the validity of the data collected by the monitoring system. If one (or more) observed operational condition(s) require(s) a check, the Field Technician must make no attempt to alter the condition(s) until the check is completed. Step-by-step instructions for performing checks are found in this section.

These operational checks are performed by the instrument Field Technician during routine site visits (minimum monthly) and recorded on Form No. DEP-06-18-A, Thermo 49iQ/49iQPS Equipment Status Report (ESR). Any field on the ESR that is not used during a site visit must be lined through and/or indicated as not being applicable by placing "N/A" in the blank field. In addition to the ESR, the operator is also required to complete Form No. DEP-01-01A, Site Visit Form, during each physical site visit. This form serves to ensure the proper documentation that various other site functions are operating as necessary.

***NOTE**: Form No. DEP-01-01A, is not specific to the 49iQ and must also be used at ambient monitoring sites even if there is no 49iQ present. Only one copy of Form No. DEP-01-01A is necessary for each site and must be contained in either a bound site logbook or be accessible on an electronic drive.*

All entries in the ESR Form DEP-06-18-A should be made concurrent with the Field Technician's observations. Information about the site, analyzer, calibrator, and data logger must be entered in the "Identification Block" as it is used to record site check results. To avoid unnecessary effort, these forms may be pre-populated with any information that is unlikely to change during the time period covered (e.g. "Identification Block" and "Standards Block). The Field Technician must ensure that any pre-printed information is correct. The "Purpose" (Site Visit or Remote Site Visit) must be chosen from the dropdown list at the top right. If "Remote Site Visit" is chosen, select fields will be grayed out.

1. Verify that the information at the top of the current ESR page is complete and accurate. If the Field Technician is beginning a new ESR, enter all the information specified in the "Identification Block" and "Standards Block". Read all identification numbers from the manufacturer label affixed to the equipment. DO NOT COPY the equipment identification information from the preceding ESR.

2. Record the date of the current site visit at the top left of the ESR.

3. Complete the following information in the "Operating Parameters" section:

   a. If one or more operating parameters of the analyzer are outside their prescribed limits, the Home Screen will display a red triangle at the bottom of the screen and the LED just to the left of the power switch will be red. If an alarm is present, press the red triangle at the bottom of the Home Screen and continue pressing the button where the alarm is indicated until the cause of the alarm is identified. Note the alarm type and action taken in the "Operator Comments" Section of the ESR. If no alarm is present, indicate "Off" next to the "System Alarm" field.

   b. From the Home Screen select "Calibration". Record the Background and Span Coefficient in the "Background" and "Span Coefficient" rows on Form No. DEP 06-18-A.

***IMPORTANT**: If either calibration factor (i.e. the ozone background or ozone coefficient) does not agree with those obtained during the most recent calibration or z/s/p check, DO NOT ADJUST that factor until a z/s/p check has been completed and the results documented on Form DEP 06-13-C. If the Zero result is within ±5.1 ppb and the span result is within ±7.1 %, do not return the calibration factors to their previous settings. Document the current calibration factors, date, and Field Technician signature in the "Comments Section" of the ESR. If the zero and span results are not within these limits, perform an adjusted calibration as outlined in Section 10.1.3 of this SOP.*

c. Return to the Home Screen by pressing the Home icon in the top left of the screen or by pressing the back arrow in the lower left of the screen.

d. Press "Settings" → "Health Check" → "Status and Alarms" → "Flow and Pressure". Record the Flow rate on the line that reads "Photometer Flow" on Form DEP-06-18-A.

e. Press the back arrow in the lower left of the screen. Select "Photometer Bench". Record the Cell A and Cell B Intensities on Form DEP-06-18-A. The user will need to press the scrolling arrows on the right of the screen to capture all the data. The "Lamp Temperature", "Bench Temperature", and "Photometer Pressure" can also be found on this screen.

f. The DAS Channel (Data Acquisition System Channel) # refers to the data logger channel configured for the Ozone Analyzer.

4. To the right side of the "Operating Parameters" section of Form No. DEP 06-18-A, record the following information:

   a. Record the instantaneous shelter temperature as indicated by the data logger in the "Shelter Temp" row.

   b. In the "Min/Max Temp" row, record the min/max thermometer values recorded by the site back-up min/max thermometer if "Site Visit" is chosen for the "Purpose". If there is an exceedance indicated by this thermometer, due diligence must be performed to ensure that no hourly averages for the internal shelter temperature exceeded the range of 0° - 45 °C. A comment must be placed in the "Operator Comments" indicating the results of this investigation. If "Remote Site Visit" is chosen for the "Purpose", the "Min/Max Temp" row will be grayed out.

   c. Inspect the analyzer's sample line for the presence of visible moisture on the interior surfaces. If the sample line and sample line filter holder are dry, write "Dry" in the "Sample Lines" space of the ESR. If moisture is found in the sample line or the sample line filter holder, place an asterisk (*) in the "Sample Lines" field. Record the location of the moisture, date, and Field Technician signature in the "Operator Comments" section of Form DEP 06-18-A. If "Remote Site Visit" is chosen for the "Purpose", the "Sample Lines" row will be grayed out.

***IMPORTANT**: DO NOT attempt to remove the moisture until a manual z/s/p check has been completed and the results documented.*

***NOTE**: In most cases, condensation in the analyzer sample line is caused by warm, moist ambient air contacting the cold surfaces of the sample line. Usually, this condition can be prevented and/or alleviated by insulating the sample line and/or increasing the temperature within the site enclosure. However, the shelter temperature may not be increased above 45 °C without invalidating data collection by the analyzer.*

5. Complete the "Analyzer Concurrency Checks" section of Form No. DEP 06-18-A as follows:

   a. Log into the Data Logger. From the Instrument Controls menu of the 49iQ, select TIME. For the cells labeled "Time Display" on Form No. DEP 06-18-A, record NIST time (NIST time at 303-499-7111) and the time of the analyzer ("Instrument"). Next, record the data logger time. If the difference is greater than 2 minutes, place the analyzer in SERVICE MODE (see Section 9.1.2C above to adjust the 49iQ time). Record any time change in the "Operator Comments" section.

   b. Navigate to the Instantaneous Readings screen of the data logger (refer to ESC Model 8832 & Digi-Trend PC Site Operations, SOP DEP-17-9, or other applicable Data Logger SOP, for instructions). Compare the instantaneous Ozone concentration value given on the screen of the analyzer to the instantaneous value given by the data logger. These values are recorded as "Instrument" and "Data Logger" on Form No. DEP 06-18-A. These two values must be within 0.5 ppb of each other. If the difference is greater than 0.5 ppb, investigate the cause of the discrepancy. Most often, a bad wiring connection between the data logger and the analyzer is to blame. If the problem is not resolved, call your agency's maintenance and repair staff for further instruction.

Table 12-2 Parameters and Tolerances

Parameter	Lower Limit	Upper Limit
Bench Pressure	720 mmHg	770 mmHg
Sample Flow	1.0 LPM	3.0 LPM
Instrument Temp	25°C	40°C
Bench Temp	15°C	40°C
Ozone Lamp Temp	55°C	65°C
Intensities	45,000 Hz	110,000 Hz

13.0 DATA ACQUISITION AND DATA MANAGEMENT

13.1. Data Acquisition

Data acquisition is accomplished using a wireless modem at the site, connected either directly to the analyzer or through an Ethernet switch interfaced with the site data logger. The central polling computer uses AirVision (or equivalent) software to poll the data wirelessly from the site, typically every hour. Refer to specific SOPs for data loggers (8832, 8872 etc.), AirVision or equivalent software, and SOP DEP 18-27, Data Handling and Data Validation for specific details regarding data acquisition.

13.2. Records Management

Records management is the process involving the management, storage, back-up, and protection of all documents associated with the operation, quality assurance, and data associated with the Thermo 49i ozone monitoring instrument. All records must be backed up, stored securely, and retained for a minimum of 5 years. State law dictates retention schedules for various records. Refer to the specific SOPs that delineate this process, including SOP DEP 18-27, Data Handling and Data Validation.

14.0 REFERENCE DOCUMENTS

1. Standard Operating Procedure for Data Handling and Data Validation, DEP 18-27, Revision No. 2, February 2022, Florida Department of Environmental Protection, Tallahassee, FL.

2. 49iQ Instruction Manual, Ozone Analyzer, ThermoFisher Scientific.

3. iQ Series Gas Analyzer Spare Parts Catalog, ThermoFisher Scientific.

4. Quality Assurance Project Plan for the State of Florida Ambient Air Quality Monitoring Program, FDEP Gaseous QAPP Revision 2, April 2022, Florida Department of Environmental Protection, Tallahassee, FL

5. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II (EPA-454/B-17-001, 1/2017

15.0 APPENDICIES

15.1. Appendix A Forms

15.1.1. Form No. DEP 06-18-A

Form No. DEP 06-18-A **Thermo 49iQ/49iQ-PS Equipment Status Report** DEP 06-18 Rev. No. 1 Effective September 2023

Identification Block							
Date Performed:		Site Name:		AQS #:		Purpose:	Site Visit
Analyzer Mfr:		Model:		Serial #:		Date Verified	
Calibrator Mfr:		Model:		Serial #:		Date Certified:	
Data Logger Mfr:		Model:		Serial #:		Date Verified:	

Standards Block							
Time Standard Mfg:		Model:		ID/Serial #:		Date Verified:	

Operating Parameters		Analyzer	Primary Standard
Parameter	Range	Value	Value
System Alarm	On/Off		
Background (ppb)	-		
Span Coefficient (ppb)	-		
Photometer Flow (LPM)	.400-1.6 LPM		
Cell A Intensity (Hz)	45000 Hz-150000 Hz		
Cell B Intensity (Hz)	45000 Hz-150000 Hz		
Lamp Temp (°C)	55-65°C		
Bench Temp (°C)	15-40° C		
O3 Lamp Temp (°C)	65-75°C	N/A	
Pressure (mmHG)	200-1000 mmHG		
Data Logger Channel #	-		

Item	Range	Value
Shelter Temp	5°C - 40°C	
Min/Max Temp	5°C - 40°C	
Sample Lines	Dry	

Analyzer Concurrency Checks							
Concurrency	NIST	Instrument	Data Logger	Difference	Difference	Difference	Limits
Time Display							± 2 minutes
Concentration Display	N/A			N/A	N/A		± 0.5 ppb

Primary Standard Concurrency Checks							
Concurrency	NIST	Instrument	Data Logger	Difference	Difference	Difference	Limits
Time Display							± 2 minutes
Concentration Display	N/A			N/A	N/A		± 0.5 ppb

Operator Comments:

Performed by: Date:

QA Comments:

Verified by: Date:

Instructions to complete Form No. DEP 06-18-A

This Equipment Status Report (ESR)is formatted as an electronic spreadsheet used specifically for the Thermo *49iQ* monitor. It is completed for all instrument operational checks.

1. Complete all the information in the Identification Block. Use the dropdown list to select Date Calibrated or Date Verified for the analyzer. Choose the Purpose using the dropdown list.

2. Complete all information in the Standards Block.

3. Record the observed values from the front panel display for the Analyzer and Primary Standard in the Operating Parameters section.

4. Record the temperature values and sample line information, if applicable. If remote site visit is chosen for the purpose, some fields will be grayed out. Enter the concurrency information as read from the Time Standard, Data Logger, Analyzer, and Primary Standard.

5. Enter Field Technician comments in the [Operator Comments) box and complete (Performed by) and (Date).

6. Enter QA comments in the (QA Comments) box and complete [Verified by) and (Date).

The operator should provide a descriptive comment indicating the purpose for completing an ESR and explain any conditions that are out of tolerance (if applicable). If maintenance is performed, complete the associated DEP Fonn No. 06-1&-B, Thermo *49iQ* Preventative Maintenance Log. If calibrations are performed, complete the associated DEP Fonn No. 06-1&-C, Thermo *49iQ* Ozone QC Check and Calibration Log. Once the ESR is complete and the specific maintenance or activities are recorded, the operator will submit the ESR and appropriate support documentation to the field technician's supervisor or quality control for accuracy and data review. The supervisor or QA authority may add comments in the QA Comment box, then sign and date the report/log.

15.1.2. Form No. DEP 06-18-B

Form No. DEP 06-18-B | **Thermo Model 49iQ Preventative Maintenance Log** | **DEP 06-18 Revision No. 1 Effective: September 2023**

Identification Block							
Year:		Site Name:		AQS #:		Auto QC Checks:	Yes
Instrument Mfr:		Model:		Serial #:			

	Maintenance Activity	Inspect Sample Line Filter	Change Sample Line Filter	Clean Instrument Interior	Sample Line Integrity Check (SLIC)	Multipoint Calibration	Check/Clean Absorption Cells	Pressure Sensor Calibration	Bench Temperature Calibration	Clean/Replace Sample Lines		
	Frequency	Monthly	Quarterly	Quarterly	Quarterly	Annually	Annually	Annually	Annually	Annually		
	Date Last Done:											
	Maintenance Due Date:										QA Reviewer	Review Date
Date	Operator											
	Maintenance Due Date:											
	Maintenance Due Date:											
	Maintenance Due Date:											
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	Maintenance Due Date:											
	Maintenance Due Date:											

Operator Comments:

QA/QC Comments:

Instructions to complete Form No. DEP 06-18-B

1. Complete the "Identification Block" with all the requested information. For the "Year", indicate the year during which the tracking form will be used.

2. Just below the "Frequency" of each maintenance item, the user or QA Authority will indicate the last date at which the maintenance item was completed (row labeled "Date Last Done"). These fields will typically be completed at the beginning of the calendar year.

3. The user will indicate on the left-hand side of each green row the date of their visit. This column is titled "Maintenance Date".

4. To the right of the "Maintenance Date", the user will enter their first initial and last name.

5. Moving left to right, the user will indicate in each dropdown menu the action taken during the visit. The possible options are listed here for clarity:

    a. Performed – the maintenance item was completed.
    b. Not Performed – this response will only be used on items that are due but are not completed. The user must make a comment in the "Operator Comments" section at the bottom of the form indicating why the maintenance item was not completed.
    c. Not Due – the maintenance item was not due during the site visit.
    d. Verified – no physical adjustments were made to the equipment, but the calibration was verified.
    e. Calibrated – the equipment was physically adjusted.
    f. Cleaned – the maintenance item was completed with a cleaning.
    g. Replaced – the maintenance item was completed by replacing the item.

15.1.3. Form No. DEP 06-18-C

Form No. DEP 06-18-C **Thermo Model 49*iQ* Ozone QC Check and Calibration Log** **DEP 06-18**
Revision No. 1
Effective: September 2023

Site Identification Block							
Date Performed:		Site Name:		Site AQS#:		Procedure:	Z/S/P Check
Data Logger Mfr:		Serial No.		Zero Air System:		Date Serviced:	
Data Logger Cal. Date:		Nightly QC Checks Done?	No				

Analyzer and Calibrator Information							
49iQ Serial Number:		Range (ppb):		**Calibrator Mfr:**	Thermo iQ	Model:	49iQ-PS
Date Calibrated:		O3 Bkg:		**Serial Number:**		O3 Bkg:	
Photometer Flow (lpm):		Span Coeff:		Certification Date:		Span Coeff:	
N/A	N/A	Pressure (mm Hg):		Cell A Flow (lpm):		Ph. Press A (mm Hg):	
Cell A Intensity (Hz):		Bench Temp (deg C):		Cell B Flow (lpm):		Ph. Press B (mm Hg):	
Cell B Intensity (Hz):		Lamp Temp (deg C):		Cell A Intensity (Hz):		Bench Temp (deg C):	
Channel Offline:		Channel Online:		Cell B Intensity (Hz):		Lamp Temp (deg C):	
Front Panel Conc.:		Data Logger Conc.:		Front Panel Conc.:		Data Logger Conc.:	
Analyzer Time:		Data Logger Time:		Calibrator Time:		Data Logger Time:	

	Data Logger Readings					
		Calibrator Value	**Analyzer Value**	**% or ppb Difference**	**Limits**	**Result**
Z/S/P Check	Unadj Zero (0 ppb)	N/A	N/A	N/A	± 5.0 ppb	N/A
	Unadj Span (250 ppb)	N/A	N/A	N/A	± 7.0%	N/A
	Precision (70 ppb)	N/A	N/A	N/A	± 7.0%	N/A
Multipoint Verification/ Calibration	Zero (0 ppb)	N/A	N/A	N/A	± 1.5 ppb	N/A
	Span (250 ppb)	N/A	N/A	N/A	± 5.0 ppb	N/A
	Midpoint (120 ppb)	N/A	N/A	N/A	See Linearity Check Below	
	Precision (70 ppb)	N/A	N/A	N/A	See Linearity Check Below	
	Low Point (40 ppb)	N/A	N/A	N/A	See Linearity Check Below	
	Final Zero	N/A	N/A	N/A	± 1.5 ppb	N/A
Post Maintenance Check	Span (250 ppb)	N/A	N/A	N/A	± 7.0%	N/A
	Precision (70 ppb)	N/A	N/A	N/A	± 7.0%	N/A
	Final Zero	N/A	N/A	N/A	± 5.0 ppb	N/A
		Sample Line Span	**SLIC Line**	**% Difference**	**Limits**	**Result**
SLIC			N/A	#VALUE!	± 2.0%	

Post Adjustment :	O3 Bkg:		Span Coeff:	

		Zero	**Span**	**Midpoint**	**Precision**	**Low Point**
Linearity Check	Calibrator Value (X)	N/A	N/A	N/A	N/A	N/A
	Analyzer Value (Y)	N/A	N/A	N/A	N/A	N/A
	Best Fit Concentration	-	N/A	N/A	N/A	N/A
	% Diff or Direct Diff (Best fit Conc vs. Y values)	-	N/A	N/A	N/A	N/A
		Limits: All points <±2.1% or ≤±1.5 ppb difference of best fit straight line, whichever is greater and slope 1 ± .05				

Slope:	N/A	Intercept:	N/A

Operator Comments

Performed By: Date

QA Comments

Verified By: Date:

Instructions to complete Form No. DEP 06-18-C

1. Complete the "Identification Block" with all the requested information. For the "Procedure", indicate what type of procedure is being completed during the site visit. For clarity, the options are defined here:

    a. Z/S/P Check – a check of the zero, precision, and span points of the analyzer. Used for bracketing data.
    b. Calibration – used when a physical adjustment to the zero and span settings of the analyzer are done.
    c. Multi Pt. Verif. – used when a multipoint check of the analyzer is completed, WITHOUT any adjustments to the zero or span settings of the analyzer.

2. For the "Zero Air System", indicate the type of zero air system in use at the site. Some of the types that may be used throughout the PQAO include pumps, compressors, scrubbers, T701, Thermo 111, etc. In the "Date Serviced" field, indicate the most recent date during which the zero-air system was refreshed with new carbon.

3. In the "Nightly QC Checks" field, indicate from the dropdown whether automated nightly QC checks are completed at the site. This will affect the control limits for the zero levels throughout the worksheet.

4. Moving down the form from top to bottom, the "Z/S/P Check" section is used for a bracketing check of the zero, span, and precision response of the analyzer. These cells are populated from the minute data gathered on the "Data Worksheet" tab at the bottom of the spreadsheet.

5. The next section, titled "Multipoint Cal/Verification" is where the results from a multipoint calibration and/or verification are recorded. The control limits in this section are tighter than a z/s/p check. The values here are populated from the "Data Worksheet" data.

6. In the next section titled "Post Maintenance Check", this is where the post-maintenance span check and zero will be recorded. This type of check will serve to verify that the analyzer is working properly after any maintenance items. The data from this section may not be used to validate data.

7. The “SLIC” section is used to record the results from a Sample Line Integrity Check”. The user will enter on the “Data Worksheet” tab, the minute averages from when the SLIC line is connected. These results will be compared to the span results from the “Z/S/P Check” section and the “% Difference” results will be automatically calculated.

8. If a physical adjustment was made to the zero and/or span settings of the analyzer, record the new O3 Bkg and Coefficient in the row labeled “Post Adjustment”.

9. The “Linearity Check” section of the form is used to check the linearity of the instrument based on the results of the calibration/verification section. This is to ensure the analyzer meets the requirements of 40 CFR Part 50, Appendix D.

10. The “Slope” and “Intercept” sections in the row just below the linearity check are automatically calculated and are used to gauge the linearity of the analyzer.

11. The “Operator Comments” section is to be used by the site operator to record any relevant information about the procedure that is not captured elsewhere. It is important to be detailed in the comments so that someone unfamiliar with the visit can make sense of it.

12. The operator must sign where indicated in “Performed By”. Either a first initial and last name or a digital signature may be used.

15.1.4. Form No. DEP 06-18-D

Form No. DEP 06-18-D **Thermo 49*iQ* Annual Verification/Calibration Form** **EFFECTIVE DATE: September 2023**

Identification Block			
Date Performed:	Site Name:	AQS #:	Parameter:
Data Logger Mfr:	Model:	Serial #:	Date Calibrated:
Calibrator Mfr:	Model:	Serial #:	Date Certified:

Standards Block			
Temp. Standard Mfr:	Model:	ID/Serial #:	Date Certified:
Flow Standard Mfr:	Model:	ID/Serial #:	Date Certified:
Pressure Standard Mfr:	Model:	ID/Serial #:	Date Certified:

Bench Temperature Verification/Calibration					
	Front Panel	Reference Standard	**Difference**	**Limits**	**RESULT**
As Found (degrees C)				± 2°C	
st Calibration (degrees C)				± 2°C	

Pressure Sensor Verification/Calibration					
Atmospheric Sensor 1	Front Panel	Reference Standard	**Difference**	**Limits**	**RESULT**
As Found (mm Hg)				± 5 mm Hg	
Post Calibration (mm Hg)				± 5 mm Hg	
Atmospheric Sensor 2	Front Panel	Reference Standard	**Difference**	**Limits**	**RESULT**
As Found (mm Hg)				± 5 mm Hg	
Post Calibration (mm Hg)				± 5 mm Hg	

Bench Lamp Intensity Verification/Calibration					
Intensity A	Front Panel	Reference Standard	**Difference**	**Limits**	**RESULT**
As Found (Hz)				± 1000 Hz	
Post Calibration (Hz)				± 1000 Hz	
Intensity B	Front Panel	Reference Standard	**Difference**	**Limits**	**RESULT**
As Found (Hz)				± 1000 Hz	
Post Calibration (Hz)				± 1000 Hz	

Flow Verification/Calibration					
Total Flow	Front Panel	Reference Standard	**Difference**	**Limits**	**RESULT**
As Found (Lpm)				± .1 Lpm	
Post Calibration (Lpm)				± .1 Lpm	

Operator Comments:

Performed by: Date:

QA Comments:

Verified by: Date:

Instructions to complete Form No. DEP 06-18-D

1. In the "Identification Block", complete the model, serial #, and date calibrated/certified for each of the items listed.

2. In the "Standards Block", complete the model, ID/Serial #, and date certified for the transfer standards being used.

3. In the "Bench Temperature Verification/Calibration" section, complete the information requested using the temperature.

4. Transfer standard (Reference Standard). Indicate the differences and the "RESULT ", as well as whether "PASS" or "CALIBRATE" based on the limits listed.

5. In the "Pressure Sensor Verification Calibration" section, complete the information requested using the Pressure transfer.

6. Standard (Reference Standard). Indicate the differences and the "RESULT", as well as whether the results are "PASS" or "CALIBRATE" based on the limits listed.

7. The operator must place a comment in the "Operator Comments" section indicating the reason for the procedure being performed, such as whether regularly scheduled or following major maintenance. They must also sign the "Performed By" field and date the form.

8. An associated copy of form No. DEP 06-18-A, Equipment Status Report, may also be turned in to the QA authority along with this form.

9. A qualified QA authority may make use of the "QA Comments" section to indicate any additional information related to QA. They must also sign in the "Verified By" field and date the document.

15.2. Appendix B Glossary

CFR	-	Code of Federal Regulations
COC	-	Chain of Custody
DAS	-	Data Acquisition System
DEP	-	Florida Department of Environmental Protection
EPA	-	U. S. Environmental Protection Agency
FAMAS	-	Florida Air Monitoring and Assessment System
FEM	-	Federal Equivalent Method
FRM	-	Federal Reference Method
Hi-VOL	-	High Volume
m3/min	-	cubic meters per minute
NAAQS	-	National Ambient Air Quality Standards
NIST	-	National Institute of Standards and Technology
PM10	-	Particulate matter with aerodynamic diameter of 10 microns or less
PQAO	-	Primary Quality Assurance Organization
QA	-	Quality Assurance
QAPP	-	Quality Assurance Project Plan
QC	-	Quality Control
SOP	-	Standard Operating Procedure
VFC	-	Volumetric Flow Controlled
VAC	-	Voltage Alternating Current