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NORTH CAROLINA
Environmental Quality

DAQ-08-006.2 Standard Operating Procedure (SOP)

Model T200UP Nitrogen Dioxide (NO-NO$_2$-NO$_X$) Monitoring System

Operator Responsibilities

Revision 2.1

January 18, 2023

NORTH CAROLINA
Department of Environmental Quality

Contents

SOP Acronym Glossary

ADQ – Audit of data quality
ARM - Envista Air Resources Manager
cc/min – cubic centimeters per minute
CFR – Code of Federal Regulations
Chief – Ambient Monitoring Section Chief
DAQ – North Carolina Division of Air Quality
DAS – Data acquisition system
° C – Degrees Celsius
DEQ – North Carolina Department of Environmental Quality
Director – Division of Air Quality Director
DIT – North Carolina Department of Information Technology
ECB – Electronics and Calibration Branch
e-log – electronic logbook
EPA – United States Environmental Protection Agency
FEM – Federal equivalent method
FRM – Federal reference method
HOBO – HOBO
IBEAM – Internet-Based Enterprise Application Management
IDL – Instrument detection limit
In-Hg A – inches mercury actual
LED – light emitting diode
LMS – North Carolina Learning Management System
LSASD – Laboratory Services and Applied Science Department
MDL – Method detection limit
mV - millivolts
NAAQS – National ambient air quality standards

NC DOT – North Carolina Department of Transportation
NIST – National Institute of Standards and Technology
NO – nitric oxide
NO_2 – nitrogen dioxide
NO_x – nitrogen oxides (NO plus NO_2)
NPAP – National Performance Audit Program
O3 or O_3 - ozone
OAQPS – Office of Air Quality Planning and Standards
PC – personal computer
Pdf – portable document format
PFA – Perfluoroalkoxy
PMT – photomultiplier tube
ppb – Parts per billion
PPB – Projects and Procedures Branch
ppm – Parts per million
psig – Pounds per square inch gauge
PZS – Precision/zero/span
QA – Quality assurance
QA/QC – Quality assurance/quality control
QAPP – Quality assurance project plan
QC – Quality control
RAMC – Regional Ambient Monitoring Coordinator
RCO – Raleigh Central Office
RRO – Raleigh Regional Office
sccm – standard cubic centimeters per minute
SOP – Standard Operating procedure
TSA – Technical systems audit
VIP – Valuing individual performance
ZPS – precision, zero, span

1.0 Approval Sign-Off Sheet

I certify that I have read and approve the contents of the Model T200UP Nitrogen Dioxide (NO-NO$_2$-NO$_x$) Monitoring System, Section II, Standard Operating Procedure, Operator Responsibilities with an effective date of January 18, 2023.

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This document, and any revisions hereto, is intended solely as a reference to assist operators in the setup, calibration, operation, and the collection of data related to the North Carolina Division of Air Quality's Ambient Monitoring Program. This document is intended as a supplement to, and not a substitute for, the education, training and experience required for the efficient operation of ambient air quality monitoring equipment and the collection of scientifically valid data, if an event affecting nitrogen dioxide (NO-NO$_2$-NO$_x$) monitoring is outside the purview of this SOP, contact the Electronics and Calibration Branch and the Raleigh Central Office for guidance.

2.0 Scope and Purpose

On February 9, 2010, the United States Environmental Protection Agency (EPA) finalized new minimum monitoring requirements for the nitrogen dioxide (NO_2) monitoring network in support of a 1-hour NO_2 National Ambient Air Quality Standard (NAAQS). In the new monitoring requirements, state and local air monitoring agencies are required to install near-road NO_2 monitoring stations at locations where peak hourly NO_2 concentrations are expected to occur within the near-road environment in larger urban areas.

In support of the new monitoring requirements, the State of North Carolina operated NO-NO_2-NO_x monitors across the state for the purpose of monitoring the ambient NO-NO_2-NO_x exposure of the general population. To collect accurate, meaningful data the monitors must be operated in a consistent manner. The goal of this document is to establish a continuous, verifiable, and defensible set of procedures and a means to record events and activities regarding the site and the instrument as required by the EPA in 40-CFR Parts 50, 53, and 58.

All original records (electronic logbook, site logbook, etc.) must be legible, complete, dated and signed or initialed by the operator and retained as a part of the permanent analyzer record. This includes both the electronic logbook (e-log) and the site logbook. The operator's name and /or initials presented on the e-log will certify that the activities indicated have been performed in accordance with this Standard Operating Procedure (SOP) and that the information contained on the form is accurate (see Appendix D for an example of an e-log). All records will be reviewed and verified by the Regional Ambient Monitoring Coordinator (RAMC) and audited by the responsible chemist at the North Carolina Division of Air Quality (DAQ) Raleigh Central Office (RCO).

3.0 Equipment Checks

In general, the T200UP NO-NO_2-NO_x analyzer system consists of the following components:

Pneumatic System: this portion of the analyzer consists of a sample inlet incorporating a heated converter, sample inlet line, particulate matter filter, gas phase titration calibration unit, ozone generator, pre-reactor, and pump, all used to bring ambient air supplies to the analyzer inlet.

Analytical System: This portion of the analyzer consists of the reaction chamber, photomultiplier, and bandpass filters.

Electronic Hardware: This portion of the analyzer consists of the electronic components that control the analyzer and process the signals.

The significant instrumentation and equipment at each DAQ NO-NO_2-NO_x monitoring site includes:
- o Teledyne Model T200UP NO-NO_2-NO_x Analyzer (T200)
- o Teledyne Model T700U Gas Calibrator
- o Teledyne Model 701 Zero Air Generator
- o Certified Primary Nitric Oxide "NO" Gas Cylinder
- o Data Management System (e.g., Envidas/Envista)
- o Ethernet / Modem connectivity
- o Uninterruptible Power Supply (UPS)
- o Dedicated Windows compatible site personal computer (PC)

Also included are HOBO back-up temperature sensors (shelter temperature), air conditioners, heaters, and other minor components not specified.

3.1 Teledyne Model T200UP NO-NO$_2$-NO$_x$ Analyzer Operational Check

Verify and record the (e-log, Logbook Tab) the T200UP instrument settings using the "<TST or TST>" buttons on the front of the instrument panel (Figure 3.1). Instrument settings should be:

1 = Concentration

2 = Instrument Mode

3 = Parameter

4 = Touch Control Button
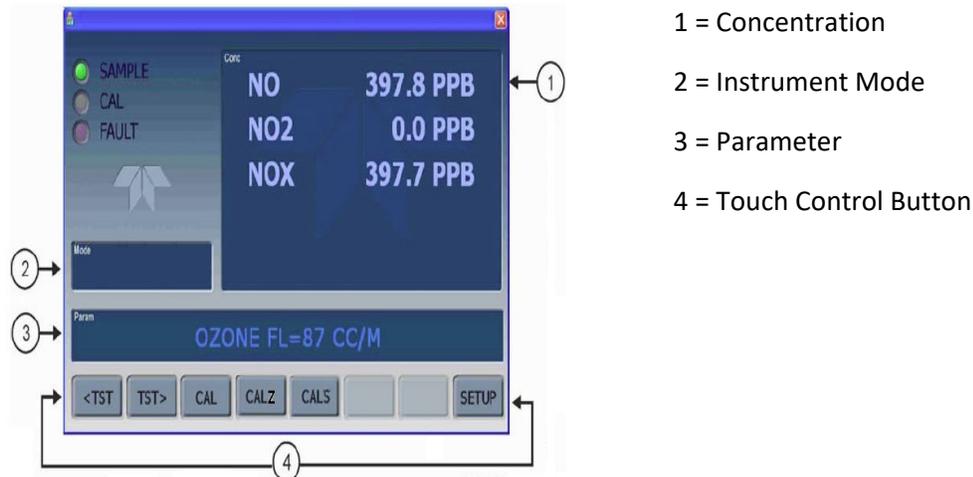
Figure 3.1 T200Up Main Menu Screen

Parameter	Expected Value
Instrument Range / Concentration Units	500 parts per billion (ppb)
RCELL Temperature	40 ± 0.1 degrees Celsius (° C)
Box Temperature	Ambient ± 5.0 ° C
Photomultiplier tube (PMT) Temperature	5.0 ± 2 ° C
RCELL Pressure	4.0 inches mercury actual (in-Hg-A)
SAMP Pressure	Ambient ± 1.0 in-Hg-A
Sample Flow (SAMP FLW)	990 – 1210 cubic centimeters per minute (cc/min)
Alarm? (Y/N)	No

A value of "XXXX" displayed for any of the parameters indicates an out-of-range reading or the analyzer's inability to calculate the parameter.

3.2 T700U Dynamic Gas Calibrator Operational Check

The most common and/or serious instrument failures will result in a warning message being displayed on the front panel of the instrument. The T700U will alert the user that a Warning Message is active by flashing the "FAULT" light emitting diode (LED) and displaying the warning message in the parameter field. The "MSG" button displays if there is more than one warning in the queue or if the instrument is placed in the "TEST" menu and messages have not been cleared.

To view or clear the various warning messages (Figure 3.2):

1. Verify the calibrator is in the "STANDBY" mode, if not Press "STBY"
2. Press "TEST" to view warning messages in the parameter field

3. Press "CLR" to clear the warning message

Figure 3.2 T700U Main Screen

NOTE: If the T700U reads "REGULATOR PRES WARN" after the ZERO/SPAN is generated, verify the "CAL PRESS" and "DIL PRESS" are 25 – 30 pounds per square inches gauge (psig) while performing SPAN 1 by scrolling through the "<TST or TST>" buttons.

Verify that the calibrator certification is in date and document the expiration date in the e-log, Logbook Tab. Calibrator certification is valid for twelve months (365 days) and the certification and/or expiration date(s) should be indicated on a label located on the front panel of the instrument.

NOTE: *The cylinder concentration displayed on the calibrator panel is a rounded value. The cylinder concentration value entered on the e-log should be the full precision concentration as stated on the calibration cylinder (i.e., 10.04 parts per million, or ppm).*

Verify that the calibrator has the correct cylinder concentration stored in memory. Cylinder concentration can be accessed from the calibrator front panel through the following steps (See Figure 3.2).

1. Make sure the calibrator is in the "STNBY" mode (if not, press "STBY")
2. Press the following keys in the order given: SETUP>GAS>CYL>>PRT1>
3. Verify the concentration entered in the calibrator corresponds to the calibration cylinder, typically ~ 10.0 PPM NO
4. Press EXIT>EXIT>EXIT>EXIT> until STNBY status is achieved

3.3 Calibration Gas Cylinder Check

Calibration gas cylinders of approximately 10.0 ppm NO are certified for four years from the original date of the manufacturer's certification. Verify that the calibration gas cylinder has not expired and document the expiration date in the e-log, Logbook Tab. If the calibration gas cylinder pressure is less than 500 psig, the ECB should be notified that a new cylinder is required. The delivery of a new gas calibration cylinder must be coordinated with the Region.

3.4 Model 701 Zero Air Generator Check

Verify that the delivery pressure is set to 30 ± 2 psig. If the delivery pressure is outside of the ± 2 psig range, adjust the pressure using the pressure adjust control knob. Document in the e-log, Logbook Tab. As the expiration date of the Model 701 Zero Air Generator approaches, contact the ECB to arrange for a Zero Air Generator that has been serviced (i.e., charged with fresh chemicals).

3.5 Site Visits and Checks

Operators are to visit the site at least once every 14 days. Upon arrival at the site, observe the outside of the shelter and the probe inlet, looking for vandalism or security breaches. Verify that the probe inlet and screen are in place and that the sample line is not blocked by insects or other debris. Document all observations and actions in the e-log, Logbook Tab.

If there is evidence of vandalism the operator should contact the local law enforcement department (generally this is the city police department if the monitor is within city limits or the County Sheriff's department if outside city limits) as well as the RAMC, the RCO and the ECB of DAQ. Unauthorized persons on the monitoring site should not be confronted by the site operator and the police should be contacted.

Specific for the Triple Oak site, operators should observe the safety guardrail put in place by the North Carolina Department of Transportation (NC DOT) that lies between the shelter and the lanes of traffic. Note in the e-log any compromises to the integrity of the safety guardrail. If the guardrail has been damaged the operator should contact the NC DOT to request repairs, as well as the RAMC, the RCO and the ECB of DAQ. To request guardrail repair, please call 1-877-368-4968 weekdays from 8:00 am until 5:00 pm. The request for repair can also be made via the [NC DOT website](#).

3.6 Shelter Temperature

Measure and record the internal temperature of the building in °C using a NIST traceable thermometer placed next to the shelter temperature sensor. Place the NIST traceable thermometer next to the temperature sensor which should be co-located with the HOBO temperature data logger (backup). If the NIST traceable thermometer was brought to the site, allow sufficient time for the reading to stabilize. Compare the temperatures of all three and record in the appropriate locations in the e-log. If the shelter temperature sensor is reading greater than ± 2° C of the reference, contact ECB.

The site thermostat should be adjusted as necessary to maintain the shelter temperature within the 20 to 30° C range. If the temperature cannot be stabilized and controlled within this range, notify the RAMC and the ECB that corrective action is required. Document in the e-log, Logbook Tab.

NOTE: Any data collected / reported must be invalidated when the temperature is out of range.

3.7 HOBO Temperature Data

The HOBO temperature data will need to be exported at least once every 30 days from the logger; refer to RCO Guidance Documents under the Documents section on DAQ's Ambient Monitoring SharePoint page for instructions. The exported temperature data file name should include specific naming parameters such as site, parameter, and date. For example, "MQ 20220601to15 ST" would be Millbrook shelter temperature between 01 Jun and 15 Jun 2022.

The exported data are considered site files and kept in accordance with section 8.0 Quality Assurance & Data Handling of this SOP. HOBO temperature data may be imported to Envista Air Resources Manager (ARM) when needed as a backup; refer to RCO Guidance Documents under the Documents section on DAQ's Ambient Monitoring SharePoint page for instructions.

3.8 Electrical Power and Sample Line Check

Observe the analyzer, calibrator, computer, and data logger for indications of a power failure and if needed, correct the cause. If the analyzer or calibrator lost power, allow an equilibration period of at least 60 minutes for the instruments to stabilize after being powered up.

Visually inspect the sample line tubing, especially at any bends to ensure that it has not kinked, crimped, cut or to ensure that insects have not nested in the lines. Particulate matter and/or moisture may also collect in the sample line leading to the instrument. Ensure that the shelter air conditioner is not blowing on the sample line, as this can cause condensation to build up in the line. Ensure that the sample line is being heated and slightly warm to the touch. The ECB is required to replace the sample line every two years and will perform a sample line integrity check during their annual audit. (Reference SOP 2.17.1, Section I: ECB Responsibilities for details). Record all events and observation in the e-log, Logbook Tab.

3.9 Time and Date Checks and Adjustments

Record the times from the site computer, analyzer, HOBO temperature data logger and from NIST on the e-log created for the site visit.

The times for the site computer and the analyzer must be set to EASTERN STANDARD TIME (UTC-5h) for North Carolina. Additionally, they must have the same time and be synched to the NIST time. Time Synchronization on the analyzer and site computer is an automated process that occurs once per day and was programmed during Envidas installation on the site computer.

NOTE: The HOBO data logger time is set to the site computer's time whenever the device is launched. Launching is required after the battery replacement and should be performed at least once every 30 days to synch time with the site computer and to export and save the monthly HOBO logger data. Refer to RCO Guidance Documents under the Documents section on DAQ's Ambient Monitoring SharePoint page for instructions.

If the times for either the analyzer, HOBO temperature data logger or site computer are not within one minute of NIST time, call ECB and they will assist with correcting the issue.

Sources for getting NIST time:
- o   Call the ECB and ask for the NIST time
- o   Call the NIST Colorado time at (303) 499-7111
- o   Correct time loaded into cell phone (Eastern Standard Time)
- o   Correct time Website: NIST time

3.10 Residence Time Check

During each Calibration, Calibration Verification or One-Point Quality Control Check the residence time of the sample line should be evaluated. Enter the sample flow rate into the e-log as well as the length of the sample line. The sample line length will be measured by ECB and recorded in the site logbook. If the

residence time results in a failure in the e-log, download diagnostics from the monitor to determine when the sample flow rate dropped below the minimum sample flow rate requirements, all data must be invalidated back to that date and time. Contact the ECB in the event of a failed residence time check or for assistance in downloading diagnostic data from the monitor.

3.11 Computer Care

At least once every 30 days, the site computer should be restarted. This will ensure that network updates from the North Carolina Department of Information Technology (DIT) take effect without a prolonged interruption of service. Operators should also contact the ECB if the site computer behaves unusually or if a piece of computer equipment needs to be replaced such as a router, PC tower, computer mouse, etc.

NOTE: DIT will have to be contacted if unable to log onto the site computer.

3.12 Particulate Filter

The particulate filter must be replaced at a minimum of every 14 days. It is recommended that when the filter is changed; handle the filter and the wetted surface of the filter housing as little as possible. Teledyne API recommends using gloves or tweezers to avoid contamination of the sample filter assembly. See Appendix B: Filter Change and Leak Check Procedure, for detailed instructions on changing the particulate filter and performing a leak check. Record filter check and leak check pass/fail (Y/N) in the e-log, Logbook Tab.

4.0 Requirements

4.1 Manual Calibration (Section 5.1)

A manual calibration followed by a multi-point calibration verification is required:
- o   When the monitor is initially installed during the site start-up
- o   When installation of a replacement monitor occurs
- o   When the system's operation is interrupted for 72-hours or longer (e.g., extended power outages caused by inclement weather)
- o   When the monitor undergoes major repairs or maintenance
- o   When the results of the automated nightly diagnostic Precision-Zero-Span (PZS) falls outside the warning limits for 2 or more consecutive days and results of a manually initiated One-Point Quality Control Check of the monitor are outside the range of acceptable criteria.
- o   When the monitor fails a multi-point calibration verification
- o   Once every 365 days or once a calendar year regardless of monitor performance

A calibration IS NOT required after the replacement of any of the following components:
- ☒   the zero-air generator
- ☒   the calibrator
- ☒   the NO cylinder on site

NOTE: This note is applicable ONLY when the very next diagnostic PZS is shown to be outside the acceptable limits (See Table 4.1). If this PZS fails, a calibration is required. It is imperative that the operator be aware of when components are changed so that the results of the next PZS can be reviewed. Therefore, arrangements with the ECB for delivery or replacement should be scheduled in advance. If a new monitor is placed into service at a site, allow for an equilibrium period before calibrating. The procedure to

calibrate the monitor and perform a multi-point calibration verification can be found in Sections 5.1 and 5.2 of this SOP.

Table 4.1 Criteria for Calibration

	ZERO	SPAN (NO)
Concentration (ppb)	0	425
Calibration Criteria (±)	1 ppb	3 %

4.2 Multi-point Calibration Verification (Section 5.2)

The purpose of a multi-point calibration verification is to correlate the output of the monitoring system with known traceable concentrations of NO-NO$_2$-NO$_x$ to demonstrate the linearity of the monitor response.

A multi-point calibration verification is required:
- o As part of any manual calibration procedure
- o Within 182 days of the most recent calibration / verification, regardless of monitor performance.

See Table 4.2 for the points run during a multi-point verification and acceptable limits.

Table 4.2 Criteria for Multi-point Calibration Verification

	ZERO	SPAN		SPAN6		SPAN4		SPAN1	
		NO	NO$_2$	NO	NO$_2$	NO	NO$_2$	NO	NO$_2$
Concentration (ppb)	0	425	405	305	285	185	165	65	45
Verification Criteria (±)	All points <± 2.1% or ≤± 1.5 ppb difference of best-fit line, whichever is greater								

4.3 One-Point Quality Control (QC) Check (Section 5.3)

The QC Check is to periodically verify that the monitor's calibration has not drifted out of the optimal range. The 1-Point QC checks are:
- o Required at least every 14 days or less (40 CFR Part 58, Appendix A, Section 3.2.1)
- o Must include a zero, spans (including titrations) and precision points (including titrations)
- o Are reported to AQS (40 CFR Part 58, Appendix A, Section 3.2), specifically the precision point

NOTE: Regardless of which detailed procedure listed above is being completed, the status of the NO-NO$_2$-NO$_x$ channels should be set using the site computer so that no data are reported during the time the procedure is being completed. *(Refer to "Marking the Channels Up or Down" in the RCO Guidance Documents folder under the Documents section of DAQ's Ambien Monitoring SharePoint page for instructions.)*

Complete the required Equipment and Site Visit Checks (Section 3.0) as specified in this SOP prior to any Calibration / Calibration Verification / One-Point QC Check.

See Section 4.1 for manual calibration requirements. Perform the following pre-calibration procedures before calibrating the Model T200UP monitor.

Table 4.3 Criteria for 1-Point QC Check

	ZERO	SPAN		SPAN6		SPAN4		SPAN1	
		NO	NO$_2$	NO	NO$_2$	NO	NO$_2$	NO	NO$_2$
Concentration (ppb)	0	425	405	305	285	185	165	65	45
Warning Limit (±)	1 ppb	≤ ±10.0 %		≤ ±10.0 %		≤ ±10.0 %		≤ ±10.0 %	
Control Limit (±)	< ± 1.5 ppb	≤ ±15.0 %		≤ ±15.0 %		≤ ±15.0 %		≤ ±15.0 %	

5.0 Detailed Procedures

5.1 Manual (adjusted) Calibration Procedure

A manual (adjusted) calibration consists of

1) setting the "Zero" using a source of zero air
2) setting the NO/NO$_x$ SPAN using calibration gas with a concentration of nominally 80% of the monitor's range (i.e., 425 ppb NO/NO$_x$)
3) setting the convertor, A and B parameters
4) performing a multi-point calibration verification

Mark the NO-NO$_2$-NO$_x$ channels down using Envidas VIEWER icon on the desktop of the site PC; refer to RCO Guidance Documents under the Documents section on DAQ's Ambient Monitoring SharePoint page for instructions. The NO-NO$_2$-NO$_x$ channels can be marked down for a specific time period to allow for the completion of a manual calibration and multi-point calibration verification if desired. See Appendix D for detailed instructions. If Appendix D is followed for marking the channels down, it is recommended the time period be set for 9 – 10 hours to allow for the calibration and both verification sequences.

Using the <TST or TST> display buttons on the T200UP display screen or *APIcom* scroll to display and record the pre-calibration settings for:
  - o   NO$_x$ slope and Offset
  - o   NO slope and Offset

Using the T200UP display screen or *APIcom* select CAL>CONC>CONV> then display and record:
  - o   SET A gain value converter efficiency
  - o   SET B gain value converter efficiency

Once the values have been recorded, reset the Converter efficiency for both A and B as follows:

1. Using the T200UP display screen or *APIcom* select CAL>CONC>CONV>SETA> then toggle the left most button until the Param Ribbon field displays 1.000, then press ENTR>
2. Press SETB> then toggle the left most buttons until the Param Ribbon field displays 1.000, then press ENTR> followed by <EXIT> <EXIT> <EXIT>
3. Change the Particulate Filter and perform a leak check (See Section 5.4 and/or Appendix B: Filter Change and Leak Check Procedure for detailed instructions and diagrams)

5.1.1 SPAN ZERO Calibration

Under the Operational Tab, using the NOXCAL Phase from Sequence menu

1. Select Phase **ZERO**

2. Change the length of time to 1 hour and select Start
3. Using the T200UP display screen or *APIcom* and the <TST or TST> buttons scroll through the menu until NOXSTB is displayed in the Param Ribbon.

NOTE: The NOXSTB is the standard deviation of concentration readings of the selected gas. Data points are recorded every ten seconds. The calculation uses the last 25 data points.

4. Allow time for the **ZERO** value being generated to stabilize (NOXSTB < 0.100)
5. Once stability is reached press **ZERO,** using the front panel of the T200UP or *APIcom*, then press ENTR> (this sets the monitor zero value)
6. Allow the monitor output to stabilize (NOXSTB < 0.100) then record
   o DIL PRES displayed by the calibrator (Logbook tab)
   o T700U_ACTDILFLOW (standard cubic centimeters per minute or sccm) T700U_ACTCALFLOW (sccm) *should be 0.0*
   o Five stable 1-minute of the **ZERO** values reported for NO-NO$_2$-NO$_x$ averages (e-log, Calibration Tab, **ZERO Calibration**)
6. Abort **ZERO**

NOTE: The measured zero for each must be less than ± 1.0 ppb.

5.1.2 SPAN Calibration
Using the NOXCAL Phase from Sequence menu

1. Select Phase **SPAN**
2. Change the length of time to 8 hours and select Start
3. Using the T200UP display screen or *APIcom* and the <TST or TST> buttons scroll through the menu until NOXSTB is displayed in the Param Ribbon.
4. Allow time for the **SPAN** values being generated to stabilize (NOXSTB < 0.200 and constant, approximately 10-20 minutes) Look for NO and NO$_x$ to be stable and within 2.0 ppb of each other and the NO$_2$ value to be 0.0 ppb ± 2.0 ppb.
5. Using Envidas Viewer, enter the
   o T700U_DILCALFLOW (sccm) (e-log, Calibration Tab)
   o T700U_ACTCALFLOW (sccm) (e-log, Calibration Tab)
Using the T200UP display or *APIcom*

6. Press <CONC> followed by <NOx> then using the left most buttons Set the NO$_x$ value to the actual calculated concentration (Calibration Tab, cell K/L13) then press <ENTR>
7. Next select <NO> then using the left most buttons set the NO value to the actual value calculated concentration (Calibration Tab, cell M/N13) then press <ENTR>
8. Press <EXIT> followed by <SPAN> <ENTR> to calibrate the **SPAN** point.
9. When the NOXSTB returns to < 0.200 (approximately 5-10 minutes) record:
   o CAL PRES displayed by the calibrator (Logbook Tab)
   o 5 stable 1-miute NO-NO$_2$-NO$_x$ averages (e-log, Calibration Tab).
NOTE: The measured NO and NO$_x$ SPAN values should be within ± 3% of the expected value.

Using the <TST or TST> display buttons on the T200UP display screen or *APIcom* scroll to display and record the post-calibration:

- o NO$_x$ slope and Offset
- o NO slope and Offset

Into the e-log, (e-log, Calibration Tab). If the NO$_x$ and/or NO Slope and Offset values are outside of the acceptable limits, maintenance of the monitor is required, and ECB should be notified.

5.1.3 Titration / Calibration

The following procedure uses gas phase titrations to calibrate the NO$_2$ channel. The two points should be located at the 80-90% (B CAL) of full scale and 10-20% (A CAL) of full scale in the order given.

5.1.3.1 GPTZ 80-90% Full Scale

1. While the calibrator is still in SPAN, and using the T700U calibrator display screen or *APIcom* press GEN>GPTZ>
2. Set the NO concentration = 425 ppb <ENTR>
3. Set the O$_3$ concentration = 405 ppb <ENTR>
4. Set the Total Flow = 3.000 LPM
5. Allow the monitor to stabilize (NOXSTB < 0.200, approximately 20 minutes)
6. Record five stable 1-minute NO-NO$_2$-NO$_x$ averages (e-log, Calibration Tab, 80 – 90% Titration Section).

5.1.3.2 GPTPS 80-90% Full Scale

1. Using the T700U calibrator display screen or *APIcom* press GEN>GPTPS>
2. Confirm the NO concentration = 425 ppb, O$_3$ concentration = 405 ppb, and Total Flow = 3.000 LPM, pressing <ENTR> after each.
3. Keep the T700U in GPTPS mode until the "ACT" value for O$_3$ is within 1 ppb of the target value entered (Active LED not flashing + 5 minutes, approximately 10 minutes).

5.1.3.3 GPT 80-90% Full Scale

1. Using the T700U calibrator display screen or *APIcom* press GEN>GPT>
2. Confirm the NO concentration = 425 ppb, O$_3$ concentration = 405 ppb, and Total Flow = 3.000 LPM, pressing <ENTR> after each. There will be no value displayed for O$_3$ during the GPT.
3. Allow the monitor to stabilize (NOXSTB < 0.200, approximately 15-20 minutes).
4. Record five stable 1-minute NO-NO$_2$-NO$_x$ averages (e-log, Calibration Tab, 80 – 90% Titration Section).

5.1.3.4 GPT 80-90% Full Scale NO$_2$ Calibration

1. Using the T200UP display panel or *APIcom*, press <CONC> <CONV> <NO2B> then using the left most buttons, edit and enter the NO2B (O$_3$) concentration which is calculated and can be found in the e-log, Calibration Tab, Titration/Calibration Section, Cell K45, once entered press <ENTR>
2. Press <CALB> to calibrate the "B" point.
3. Press <CAL> <ENTR> <EXIT> <SETB>
4. Record the "SETB Gain" Converter Efficiency value on the front panel display *(e-log, Calibration Tab, 80 – 90% Titration Section, After Adj. Converter Efficiency Box).*
5. Press <EXIT> <EXIT> <EXIT> to leave the concentration menu.

5.1.3.5 GPTZ 10-20% Full Scale

1. Using the T700U calibrator display screen or *APIcom* press GEN>GPTZ>

2. Set the NO concentration = 65 ppb <ENTR>
3. Set the O_3 concentration = 45 ppb <ENTR>
4. Set the Total Flow = 3.000 LPM
5. Allow the monitor to stabilize, (NOXSTB < 0.200, approximately 15-20 minutes)
6. Record five stable 1-minute NO-NO_2-NO_x averages (e-log, Calibration Tab, 10 – 20% Titration Section)

5.1.3.6 GPTPS 10-20% Full Scale

1. Using the T700U calibrator display screen or *APIcom* press GEN>GPTPS>
2. Confirm the NO concentration = 65 ppb, O_3 concentration = 45 ppb, and Total Flow = 3.000 LPM, pressing <ENTR> after each.
3. Keep the T700U in GPTPS mode until the "ACT" value for O_3 is within 1 ppb of the target value entered (Active LED not flashing + 5 minutes, approximately 10 minutes)

5.1.3.7 GPT 10-20% Full Scale

1. Using the T700U calibrator display screen or *APIcom* press GEN>GPT>
2. Confirm the NO concentration = 65 ppb, O_3 concentration = 45 ppb, and Total Flow = 3.000 LPM, pressing <ENTR> after each. There will be no value displayed for O_3 during the GPT.
3. Allow the monitor to stabilize (NOXSTB < 0.200, approximately 15-20 minutes)
4. Record five stable 1-minute NO-NO_2-NO_x averages (e-log, Calibration Tab, 10 – 20% Titration Section)

5.1.3.8 GPT 10-20% Full Scale NO_2 Calibration

1. Using the T200UP display panel or *APIcom*, press <CONC> <CONV> <NO2A> then using the left most buttons, edit and enter the NO2A (O_3) concentration which is calculated and can be found in the e-log, Calibration Tab, 10 – 20% Titration Section, Cell K61, once entered press <ENTR>
2. Press <CALA> to calibrate the "A" point
3. Press <CAL> <ENTR> <EXIT> <SETA>
4. Record the "SETA Gain" Converter Efficiency value on the front panel display *(e-log, Calibration Tab, 10 -20% Titration Section, After Adj. Converter Efficiency Box).*
5. Press <EXIT> <EXIT> <EXIT> to leave the converter efficiency menu

After completing the calibration procedure, it is important to evaluate the monitor's calibration SLOPE and OFFSET parameters. These values describe the linear response curve of the analyzer, separately for NO and NO_x. Ensure that the values are within the limits listed below, if not contact ECB.

Function	Minimum Value	Optimum Value	Maximum Value
NOx Slope	-0.700	1.000	1.0 ± 0.3
NOx Offset	-20.0 millivolt (mV)	0.0 mV	150 mV
NO Slope	-0.700	1.000	1.0 ± 0.3
NO Offset	-20.0 mV	0.0 mV	150 mV

6. Abort **SPAN**
7. Reset all Flags if the channels were manually downed, then using Envidas Viewer schedule T200VER1 and T200VER2 (see Section 5.2)

8. If the channel was marked down using the "Force Status Time" option, the channels will return to "OK" status once the Force Status countdown is complete.

NOTE: Once a sequence is initiated the status of the monitor will change automatically and be taken offline. Once the sequence is complete the status of the monitor will return to "OK" – there is no need to mark the channels down or up if the sequences are run using the Scheduler.

5.2 Multi-Point Calibration Verification Procedure

The purpose of this procedure is to "verify" the linearity of the monitor at multiple concentrations after the completion of a calibration. At an operator's discretion, a multi-point calibration verification can be performed to support weight of evidence.

A multi-point calibration verification is required:
- o After every calibration
- o Every 6 months or within 182 days of the most recent calibration

To ensure that the adjustments made in a calibration are successful, each point of the multi-point verification should be checked. The multi-point calibration verification consists of two (2) precisely timed sequences that should be run consecutively using the follow the steps:

1. Using Envidas VIEWER module on the site computer.
2. Under the "Operational" tab select [Sequence], and then choose "T200VER1"
3. Schedule the sequence to start to a number value that will allow the sequence to start at "0 minutes" and click "Start."
4. The sequence will start at the top of the next minute time point. A countdown will appear in the dialog box.
5. Once the sequence for "T200VER1" begins, using the "Operational" tab _immediately_ schedule the [Sequence] "T200VER2." Set the time to start to in 155 – 160 minutes and click "Start."

5.2.1   T200VER1

NOTE: T200VER1 consists of seven phases and a purge created and timed to produce a consistent repeatable result. The T200VER1 is the first part of the calibration verification process and is used to verify the upper portion of the monitor's linearity after a calibration. The run time for the T20VER1 sequence is 2 hours and 30 minutes (150 minutes total) from beginning to end and includes a 5-minute purge.

The T200VER1 sequence consists of:
1. Running a ZERO point – T700U_ACTDILFLOW and five 1-minute averages are collected for NO-NO$_2$-NO$_x$ zero. (The T700U_ACTCALFLOW value should be 0.0 sccm when running the ZERO point.)
2. Running a GPTZ at 425 ppb NO and 405 ppb O$_3$ – when completed, T700U_ACTDILFLOW, T700U_ACTCALFLOW, T700U_O3GENFLOW and five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 10) using the values from Reporter averages for NO-NO$_2$-NO$_x$.
3. Running a GPTPS – _no minute data are recorded in the e-log_
4. Running a GPT – five 1-minute averages will need to be recorded in the e-log, (GPT Worksheet Tab, SPAN) using the values from Reporter averages are collected for NO-NO$_2$-NO$_x$

5. Running a GPTZ at 305 ppb NO and 285 ppb O_3 – when completed, T700U_ACTDILFLOW, T700U_ACTCALFLOW, T700U_O3GENFLOW five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 8) using the values from Reporter averages are collected for NO-NO_2-NO_x

6. Running a GPTPS – *no minute data are recorded in the e-log*

7. Running a GPT – five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 6) using the values from Reporter averages for NO-NO_2-NO_x

8. When the T200UVER1 is complete the sequence T200UVER2 will follow T200UVER1 if scheduled. And will initiate itself. If the sequence fails to start and using Envidas VIEWER, under the "Operational" tab select [Sequence], then choose "T200UVER2"

9. Schedule the sequence to start to a number value that will allow the sequence to start at "0 minutes" and click "Start."

10. The sequence will start at the top of the next minute time point. A countdown will appear in the dialog box.

5.2.2 T200VER2

NOTE: T200VER2 consists of six phases and a purge created and timed to produce a consistent repeatable result. The T200VER2 is the second part of the calibration verification process and is used to verify the lower portion of the monitor's linearity after a calibration. The run time for the T20VER2 sequence is 2 hours and 15 minutes (135 minutes total) from beginning to end and includes a 5-minute purge.

The T200VER2 sequence consists of:
1. Running a GPTZ at 185 ppb NO and 165 ppb O_3 – when completed, T700U_ACTDILFLOW, T700U_ACTCALFLOW, T700U_O3GENFLOW and five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 6) using the values from Reporter averages for NO-NO_2-NO_x

2. Running a GPTPS – *no minute data are recorded in the e-log*

3. Running a GPT – five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 4) using the values from Reporter averages for NO-NO_2-NO_x

4. Running a GPTZ at 65 ppb NO and 45 ppb O_3 – when completed, T700U_ACTDILFLOW, T700U_ACTCALFLOW, T700U_O3GENFLOW and five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 3) using the values from Reporter averages for NO-NO_2-NO_x

5. Running a GPTPS – *no minute data are recorded in the e-log*

6. Running a GPT – five 1-minute averages will need to be recorded in the e-log (GPT Worksheet Tab, SPAN 1) using the values from Reporter averages for NO-NO_2-NO_x

7. When the T200VER1 and T200VER2 are complete, using Envidas Reporter, generate a minute data report that contains:
    o NO-NO_2-NO_x minute average values during time periods the T200VER1 and T200VER2 sequences were run. The last five-minute average values for each during each SPAN event will be used to complete the GPT worksheet.

- o T700U_ACTCALFLOW (cubic centimeters per minute or cc/min) – the one-minute value that corresponds with the first 5-minute average value during each SPAN event will be used to complete the GPT worksheet.
- o T700U_ACTDILFLOW (cc/min) – the one-minute value that corresponds with the first 5-minute average value during each SPAN event will be used to complete the GPT worksheet.
- o T700U_O3GENFLOW (CC/min) – the one-minute value that corresponds with the first 5-minute average value during each SPAN event will be used to complete the GPT worksheet.
8. Using the values from the minute data report generated, complete the GPT Worksheet tab, ZERO, T200VER1 and T200VER2 sections of the e-log to verify the linearity of the calibration procedure and to view the results.

The calibration verification must show that all points are < ± 2.1 percent or ≤ 1.5 ppb difference of best-fit line whichever is greater and Slope 1 ± 0.05 to be acceptable. The e-log will calculate these values for $NO\text{-}NO_2\text{-}NO_x$. If any of the values are outside the acceptance criteria given in Table 4.2 the calibration verification must be re-run to identify and correct any problems. If a second attempt fails, contact the ECB for guidance.

Mark the $NO\text{-}NO_2\text{-}NO_x$ channels back up after the completion of the calibration verification; refer to RCO Guidance Documents under the Documents section of DAQ's Ambient Monitoring SharePoint page for instructions. If the channel was marked down using the "Force Status Time" option, the channels will return to "OK" status once the countdown is complete.

NOTE: Once a sequence is complete the status of the monitor will return to "OK" – there is no need to mark the channels down or up if the sequences are run using the Scheduler.

5.3 One-Point QC Check (14-Day Check)

The purpose of the 14-Day check is to correlate the output of a monitoring system with known traceable concentrations of $NO\text{-}NO_2\text{-}NO_x$, and to periodically confirm that the monitor's calibration has not drifted outside the acceptable range. The EPA refers to calibration checks as "One Point QC Checks" (Reference 40 CFR Part 58, Appendix A, Section 3.2.1) and requires that 1-point QC check be performed at least once every 14-days. As part of a 1-point QC check, perform a precision check and two (2) titration checks. Refer to Section 3.0 for equipment checks that need to be completed prior to starting a 1-point QC Check.

Mark the $NO\text{-}NO_2\text{-}NO_x$ channels down using Envidas VIEWER icon on the desktop of the site PC; refer to RCO Guidance Documents under the Documents section on DAQ's Ambien Monitoring SharePoint page for instructions.

In the Envidas "Viewer" module, under the "Operational" tab, select "Sequence" and choose "T200 14 DAY CK"

Schedule the time to start in 0 (zero) minutes and click "Start"

The sequence will start at the top of the next minute. A countdown will appear in the dialog box.

5.3.1 T200 14 DAY CK

NOTE: T200 14 DAY CK consists of seven phases and a purge created and timed to produce a consistent repeatable result. The T200 14 DAY CK is to verify that the monitor's calibration has not drifted out of

optimal range. Results of the T200 14 DAY CK are reported to AQS using an AQ-98 form on a quarterly basis. The run time for the T200 14 DAY CK sequence is 2 hours and 30 minutes (150 minutes total) from beginning to end and includes a 5-minute purge.

The T200 14 DAY CK sequence consists of:

1. Running a ZERO point – T700U_ACTDILFLOW and five 1-minute averages are collected for NO-NO$_2$-NO$_x$ zero. (The T700U_ACTCALFLOW value should be 0.0 sccm when running the ZERO point.) When completed five 1-minute averages will need to be recorded in the e-log (QC Check Tab, ZERO Section)
2. Running a GPTZ at 425 ppb NO and 405 ppb O$_3$ – when completed, T700U_ACTDILFLOW, T700U_ACTCALFLOW, T700U_O3GENFLOW and five 1-minute averages will need to be recorded in the e-log (QC Check Tab, SPAN Section, SPAN 10) using the values from Reporter averages for NO-NO$_2$-NO$_x$
3. Running a GPTPS – *no minute data are recorded in the e-log*
4. Running a GPT – five 1-minute averages will need to be recorded in the e-log, (QC Check Tab, SPAN Section, SPAN) using the values from Reporter averages for NO-NO$_2$-NO$_x$
5. Running a GPTZ at 65 ppb NO and 45 ppb O$_3$ – when completed, T700U_ACTDILFLOW, T700U_ACTCALFLOW, T700U_O3GENFLOW and five 1-minute averages will need to be recorded in the e-log (QC Check Tab, Precision Section, SPAN 3) for NO-NO$_2$-NO$_x$
6. Running a GPTPS – *no minute data are recorded in the e-log*
7. Running a GPT – five 1-minute averages will need to be recorded in the e-log (QC Check Tab, Precision Section, SPAN 1) using the values from Reporter averages for NO-NO$_2$-NO$_x$
8. When the "T200 14 DAY CK" is complete, using Envidas Reporter, generate a minute data report that contains:
    o   NO-NO$_2$-NO$_x$ minute average values during time periods the T200 14 DAY CK sequences was run. The last five-minute average values for each during each SPAN event will be used to complete the GPT worksheet.
    o   T700U_ACTCALFLOW (cc/min) – the one-minute value that corresponds with the first 5-minute average value during each SPAN event will be used to complete the GPT worksheet.
    o   T700U_ACTDILFLOW (cc/min) – the one-minute value that corresponds with the first 5-minute average value during each SPAN event will be used to complete the GPT worksheet.
    o   T700U_O3GENFLOW (CC/min) – the one-minute value that corresponds with the first 5-minute average value during each SPAN event will be used to complete the GPT worksheet.
9. Using the values from the minute data report generated, complete the QC Check tab of the e-log to complete the1-Point QC Check procedure and view the results. (The values entered into the QC Check Worksheet tab will automatically populate the NO-NO$_2$-NO$_x$ values that will be reported to AQS as well as the converter efficiency of the photolytic converter. It is recommended the Converter efficiency values should be between ≥ 96% - 104.1%.

NOTE: The measured zero value must be within ± 1.0 ppb.
The measured span values must be within 10% of the expected target concentrations.
The measured Precision point values must be within 10% of the expected target concentrations.

If any of the points are outside the QC check tolerance for the full-scale range, the QC check is unacceptable. If the QC check is unacceptable after two (2) attempts, contact ECB and/or conduct the required manual calibration followed by a calibration verification.

Acceptance Criteria for each 1-Point QC Check Point are:

	Zero	Span (NO/NO$_x$)	Span (NO$_2$)	Precision (NO/NO$_x$)	Precision (NO$_2$)
Concentration (ppb)	0	425 ppb	405 ppb	65 ppb	45 ppb
Warning Limit (±)	1.0 ppb	10 %	10 %	10 %	10 %
Control Limit (±)	≤ ± 1.0 ppb	15 %	15 %	15 %	15 %

NOTE: The T700U_ACTCONC value NO and NO$_x$ ppb gas concentration value (cell D42, GPTZ SPAN 3, on the 14-day Check tab) are reported as the Actual/Standard values to AQS using the AQ98 form. The Precision NO and NO$_x$ gas concentrations (cells H45 and J45) on the QC Check tab) are reported as the Indicated/Monitor values to AQS using the AQ98 form.

The Precision NO$_2$ ppb gas concentration value (cell U39, NO2 CA, on the 14-day Check tab) is reported as the Actual/Standard value to AQS using the AQ98 form. The Precision NO$_2$ gas concentrations (cell N45 on the QC Check tab) are reported as the Indicated/Monitor value to AQS using the AQ98 form.

10. Change the T200UP Filter and Perform a Leak Check (Section 5.4)
11. Mark the NO-NO$_2$-NO$_x$ channels back up after the completion of the calibration check and filter change; refer to RCO Guidance Documents under the Documents section of DAQ's Ambient Monitoring SharePoint page for instructions. *Do not mark the channel up until the filter change and leak check have been completed.* If the channel was marked down using the "Force Status Time" option, the channels will return to "OK" status once the countdown is complete.

5.4 Filter Change and Leak Check Procedure
The particulate filter should be changed every 14 days or less. When the filter (PN 002730000) is changed, handle it and the wetted surfaces of the filter housing as little as possible. Teledyne API recommends using gloves or tweezers to avoid contamination of the sample filter. To change the filter, the T200UP should be in the "SAMPLE" mode.

5.4.1 Filter Change
1. Disconnect the exhaust port line form the instrument rear panel (see Appendix B, Figure 1)
2. Open the T200UP's hinged front panel and unscrew the hold down ring on the filter assembly (see Appendix B, Figure 2 and Figure 3)
3. Carefully remove the hold down ring, glass window, nitrile O-ring, PTFE O-ring with notches and filter element.
4. Replace the filter, being careful that the element is fully seated and centered in the bottom of the holder.
5. Reinstall the PTFE O-ring <u>with the notches up and aligned with the hole</u>, nitrile O-ring, the glass window; screw on the hold down ring, hand tighten. Inspect the seal between the edge of the filter and the PTFE O-ring to assure a proper seal.

6. Reconnect the exhaust port line to the instrument and record the date of filter change (e-log, Logbook Tab). The filter does not require conditioning.

5.4.2 Leak Check Procedure

1. Remove the top cover and cap the O_3 dryer vent (see Appendix B, Figure 4).
2. Remove the sample line and cap the sample port (see Appendix B, Figure 2). Cap must be wrench tight.
3. After several minutes, note the "RCEL" pressure and the "SAMP" pressure using the "<TST" or "TST>" keys on the front panel of the T200UP. If both readings are withing 0.2 In-Hg-A of each other, the pump is in good condition and the leak check passed.
4. Remove the caps and reconnect the sample line, replace the cover.
5. Record leak check pass/fail (Y/N) (e-log, Logbook Tab)>

6.0 Logbook Submittal and Data Retrieval

6.1 Logbook Submittal

The NO-NO_2-NO_x e-log or electronic logbook, serves as the transfer record and document for evaluation of the success or failure of the operation of the NO-NO_2-NO_x monitoring site and is the essential record for determining the quality of the NO-NO_2-NO_x data reported from each site.

The Site Operator must complete the NO-NO_2-NO_x e-log to document the purpose of every site visit, the observations and finding during the site visit, and the evaluation of the performance of the NO-NO_2-NO_x monitoring system for each site visit. This includes any and all startups and shutdowns (including severe weather events, temperature extremes, and etc.).

The site operator must submit the NO-NO_2-NO_x e-log to the RAMC or designee for review and comment as soon as possible after the site visit and at a minimum by the end of each month. Additionally, a site logbook page should be annotated with any site visit. Additionally, a site logbook page should be annotated with any site visit (i.e., shutting down for approaching weather, start-ups, and shutdowns, and etc.) Each site visit should provide an e-log and an entry in the site logbook stating at a minimum, a purpose for the visit.

The RAMC or designee must review site operator monthly submitted NO-NO_2-NO_x e-logs for each site in their region and evaluate each e-log for completeness and operator adherence to operating procedures. The RAMC must also consider and compare all NO-NO_2-NO_x e-logs submitted for all NO-NO_2-NO_x sited in the region to determine if a pattern of operation is negatively impacting the NO-NO_2-NO_x sited in that region. Following the review, the RAMC must initial and submit each NO-NO_2-NO_x logbook to the RCO chemist for review.

The RCO chemist must revie the logbooks submitted by each region from all NO-NO_2-NO_x sites for completeness and adherence to operating procedures. The RCO chemist must also review the logbook submitted from each site and from all regions to determine if there is a procedure or pattern of operation that may be negatively impacting the overall operation of the NO-NO_2-NO_x monitoring network and the quality of the NO-NO_2-NO_x data reported.

6.2 Data Retrieval and End Processing

Every business day, the RCO statistician initiated a data review for the previous day by providing a raw data report (in spreadsheet format) to each RO (Reference DAQ-15-005.5 Data Verification and Validation for Continuous Gaseous Monitors, Revision 2.0, May 1, 2022). The RCO chemist may request the regional operator (RO) to send additional data that are needed beyond what the RCO requires for verifying any missing data supplied by the RO. These data can be retrieved from the "site monitor"; reference RCO Guidance Document under the Documents section on DAQ's Ambient Monitoring SharePoint page for instructions.

7.0 File Management

Site operators must have a PC (or laptop) to generate the e-log files from a Microsoft Excel template file. These e-logs are provided by the RCO and updated periodically. The file naming protocol is provided below. A formalized file naming convention has been established through consensus of the regions and the RCO and should be used for all e-logs.

7.1 Opening, Naming and Storing the Site Files

The e-log template file used at the site should be stored on the PC used for field operations by the field technicians (see Appendix D for an example of the e-log). E-logs can also be found in Laserfiche. To access this file, open the e-log template file using Excel. 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 or tabs) to preserve the record. *Do not* copy over a previously completed e-log.

NOTE: Refer to the logbook file naming convention "Policy Memorandum" dated January 1, 2011, located in the Laserfiche Ambient Monitoring module (summarized below).

Renaming and saving the e-log
1. Open the e-log workbook template file using Excel
2. Left click the "file" toolbar icon. Scroll down to "Save As" and left click
3. Under file name (highlighted) change workbook file name using the format: Site ID NO-NO2-NOx Date Activity. For example, TO NO2 20220916 AX.xls is a site visit at Triple Oak on September 16, 2022
4. Change save location to operator's choice of folders
5. Left click "Save"
6. Find the tab needed for the task(s) involved. The first tab should be the Logbook tab. Fill in information as indicated.

8.0 Quality Assurance & Data Handling

All site files, e-logs or other supporting documents generated in the field will be stored on dedicated server space in the RO in a folder name for the official site operation files. These files should be transferred to the official file on a frequent and regular schedule as established by the RO. This is necessary to prevent the potential loss of such files from the field computer and to maintain a "paper trail" for providing defensible data. This also makes the data easily and readily available for review by the RAMC and transfer

to the RCO group drive for review by the RCO. The files on the site or operator PC can be copied and transferred to the common hard drive via email or flash drive for storage in the official file folder.

The site files should be transferred every three business days and backed up monthly. This serves as a backup system in the event the official PC fails or is removed, or the site files are damaged. These files will be retained for a minimum of five years. When the need arises to review a file for data verification or site operations, the official folder is used, or a hardcopy is created from this file. For detail on data validation procedures, please reference DAQ-15-005.5 Data Verification and Validation for Continuous Gaseous Monitors, Revision 2.0, May 1, 2022). The following verification checks shall be completed every month:

- o Providing proper null codes indicating calibrations, audits, etc.
- o Providing missing valid data
- o Documenting any invalid data as to reason with proper null code
- o Identifying any data that may be associated with exceptional events

8.1 NO-NO$_2$-NO$_x$ Monthly Data Verification

Preliminary verification is completed by the RO operator. The operator must account for and identify the reasons for missing or invalid data within Envista using proper flags and null codes while performing maintenance or shortly thereafter. The operator must review the previous month of data and add any flags or void codes to the status column as necessary. For each changed status, a comment must be entered with a description of why the status was changed.

The RAMC will perform the second level review of the month of data, adding any additional void codes and comments, and requesting additional information from the operator as necessary. If required, the RAMC can send data back to the RO operator for additional comments or to correct any codes. When possible, the data will be validated within 20 calendar days from the end of the collection month.

The RCO chemist performs the final validation of the one-month period of data. Void codes and comments should all be added, and the RCO chemist can send the data back to the previous reviewer. Final validation of the data should be completed withing 40 calendar days of the end of the collection month. Once the data have been approved and have had the "final validation" label applied by the RCO chemist, they are automatically entered into a queue within Envista ARM. The database manager will send all approved data to AQS automatically on a regularly scheduled basis.

In some cases, "valid" data that are judged to be out of the ordinary are retained and an informational flag is added in AQS by the RCO. An example would be high concentration values resulting from an exceptional event. EPA has recently begun applying stricter standards for what it will accept as an exceptional event. In any case, where the RO wishes data to be considered "exceptional," the RO should gather sufficient documentation to support the claim in accordance with a policy memorandum from the RCO dated June 29, 2007. Unusually high concentration values that may be the result of an exceptional event must be flagged in AQS by the RCO using the appropriate informational qualifier code. The fully validated file of data is then uploaded into AQS by the RCO.

A list of Null Codes that are routine used during data verification on the AQS monthly summary report are listed in the following table.

Code	Meaning
AE	Shelter Temperature outside Limits
AN	Machine or Equipment Malfunction
AS	Poor Quality Assurance Results
AT	Calibration
AV	Power Failure
AZ	QC (ECB) Audit
BA	Maintenance and Routine Repairs (including filter change
BB	Unable to Reach Site
BC	Multi-point Calibration
BD	Auto Calibration
BF	Precision/Zero/Span
BJ	Operator Error
BK	Site Computer/ Data Logger Down
SA	Storm Approaching
QV	Multi-point Calibration Verification

9.0 Troubleshooting and Corrective Actions

Problem / Observation	Fault Condition	Corrective Action
BOX TEMP WARNING	Box Temp is <7 °C or >48 °C	Poor blocked ventilation Stopped Exhaust Fan Ambient Temperature outside of specified range
OZONE FLOW WARNING	O_3 flow rate <50 cc/min or > 150 cc/min	Failed Sample Pump Blocked O_3 dryer Blocked inlet/outlet to O_3 purifier Leak downstream of RCELL Failed O_3 Sensor
PMT TEMP WARNING	PMT temperature is < 3 °C or > 7 °C	PMT fan not operating Failed PMT Temperature Sensor TEC not functioning Failed PMT Preamp PCA
RCELL PRESS WARN	Sample Pressure is <15 in-Hg or >32 in-Hg	If Sample Pressure <15 in-Hg: Blocked Particulate Filter Failed Pressure Senor/circuitry If Sample Pressure >35 in-HG: Bad Pressure Sensor/circuitry Pressure too high at Sample Inlet
RCELL TEMP WARNING	RCELL temperature is <45°C or >55°C	Failed RCELL Temperature Sensor Relay controlling the heater is not working Failed Relay Board
SAMPLE FLOW WARN	Sample flow rate is <350 cc/min or >600 cc/min	Failed Sample Pump Blocked Sample Inlet/Gas Line Dirty Particulate Filter Leak Downstream of RCELL Critical Flow Orifice

Problem / Observation	Fault Condition	Corrective Action
		Failed Sample Pump Sensor
		Failed Vacuum Pressure Sensor
SYSTEM RESET	The computer has rebooted	The message occurs at power on
		Fatal Error caused software to restart
		Loose connector/wiring
RCell Pressure or SPAN response increasing	External Pump may be failing	Notify ECB for corrective actions

10.0 Revision History

1. Complete revision of SOP 2.17.2 R1.1 – all sections and procedures

10 Jan 2023

2. Section 3.5 – added paragraph for operators to observe the safety guardrail at the Triple Oak site and report any compromise in the integrity in the e-log and to NC DOT.
3. Section 5.1.1, Item 5 – added text "using front panel of T200UP or *APIcom*, then press ENTR>"
4. Section 5.1.2, Item 4 – correct typo "withing to within"
5. Section 5.1.2 – change "Logbook tab to Calibration Tab"
6. Section 5.1.3.5, Item 1 – correct cell reference to "K45"
7. Section 5.1.3.7 – Correct labeling from "GPTZ to GPT"
8. Section 5.1.3.8, Item 1 – correct cell reference to "K61"
9. Section 5.2.1, Item 9 – correct typo "the" to "then"
10. Section 5.2 – Added text to NOTE: detailing length of Sequence T200VER1 and moved NOTE: to the beginning of Section 5.2.1
11. Section 5.2.1 – Added text to NOTE: detaining length of Sequence T200VER2 and moved NOTE: to the beginning of Section 5.2.2.
12. Section 5.3 – Added text to NOTE: detailing length of Sequence T200 14 DAY CK and moved NOTE: to the beginning of Section 5.3.1.
13. Section 5.3.1 - Acceptance Criteria for each 1-Point QC Check Point – corrected Warning Limit for SPAN (NO/NO_x and SPAN (NO_2) changed 8% to 10%.
14. Section 5.3.1, edited text of NOTE at end of Section for how 1-Point QC checks are reported to AQS:

> "The T700U_ACTCONC value NO and NO_x ppb gas concentration value (cell D42, GPTZ SPAN 3, on the 14-day Check tab) are reported as the Actual/Standard values to AQS using the AQ98 form. The Precision NO and NO_x gas concentrations (cells H45 and J45) on the QC Check tab) are reported as the Indicated/Monitor values to AQS using the AQ98 form.
>
> The Precision NO_2 ppb gas concentration value (cell U39, NO2 CA, on the 14-day Check tab) is reported as the Actual/Standard value to AQS using the AQ98 form. The Precision NO_2 gas concentrations (cell N45 on the QC Check tab) are reported as the Indicated/Monitor value to AQS using the AQ98 form."

15. Appendix A: Envidas Sequence / Phase Settings – added column for "Minutes to Complete" for each Sequence.

11.0 References

1. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II, Part 1, Ambient Air Quality Monitoring Program, EPA-454/B-17-001, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Assessment Division, Research Triangle Park, NC 27711. Link

2. Code of Federal Regulation: "Title 40: Protection of the Environment", U.S. Government, June 5, 2019. Link

3. QA Handbook Appendix D Validation Templates, U.S. Environmental Protection Agency, March 2017. Link

4. DAQ-15-005.5 Data Validation for Continuous Gaseous Monitors and Meteorological Data, Raleigh Central Office Responsibilities, Revision 2.0, May 1, 2022. Link

5. Envidas Ultimate, Continuous Emission, Air and Water Quality Monitoring System, Revision 1.3.17, March 2017 Link

6. Models T200U and T200UP photolytic NO/NO2/NOx Analyzer with NumaView™ Software (Part Number 083730229 Rev01) 30 March 2017 Link

7. Models T200U and T200UP Photolytic NO/NO2/NOx Analyzer with NumaView™ Software Manual (Part Number 083730229 Rev01) 01 November 2017 Link

12.0 Appendices

Appendix A: Envidas Sequence / Phase Settings
Appendix B: Filter Change and Leak Check Procedure
Appendix C: Common Continuous Monitoring Principles Applicable to the NO-NO2-NOx System
Appendix D: Example of e-log
Appendix E: Glossary of Terms
Appendix F: Guidance for Useful Logbook Documentation

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Appendix A: Envidas Sequence / Phase Settings

T200VER1	Phase	Concentration NO/NO$_x$ (ppb)	Concentration NO$_2$ (ppb)	Minutes to Complete
ZERO	ZERO	0	0	15
GPTZ	SPAN10	425	405	25
GPTPS [1]	SPAN9	425	405	15
GPT	SPAN	425	405	25
GPTZ	SPAN8	305	285	25
GPTPS [1]	SPAN7	305	285	15
GPT	SPAN6	305	285	25
Purge	Purge	N/A	N/A	5

T200VER2	Phase	Concentration NO/NO$_x$ (ppb)	Concentration NO$_2$ (ppb)	Minutes to Complete
GPTZ	SPAN6	185	165	25
GPTPS [1]	SPAN5	185	165	15
GPT	SPAN4	185	165	25
GPTZ	SPAN3	65	45	25
GPTPS [1]	SPAN2	65	45	15
GPT	SPAN1	65	45	25
Purge	Purge	N/A	N/A	5

T200 14 DAY Check	Phase	Concentration NO/NO$_x$ (ppb)	Concentration NO$_2$ (ppb)	Minutes to Complete
ZERO	ZERO	0	0	15
GPTZ	SPAN10	425	405	25
GPTPS [1]	SPAN9	425	405	15
GPT	SPAN	425	405	25
GPTZ	SPAN3	65	45	25
GPTPS [1]	SPAN	65	45	15
GPT	SPAN1	65	45	25
Purge	Purge	N/A	N/A	5

[1] Data are collected by Envidas software installed on the site computer but are not recorded in the e-log.

Appendix B: Filter Change and Leak Check Procedure

Filter Change

The particulate filter should be changed every 14 days or less. When filter (PN 002730000) is changed handle it and the wetted surfaces of the filter housing as little as possible. Teledyne API recommends using gloves or tweezers to avoid contamination of the sample filter. To change the filter, the T200UP should be in the "SAMPLE" mode:

1. Remove the exhaust port line from the instrument rear panel (see **Figure 1**).
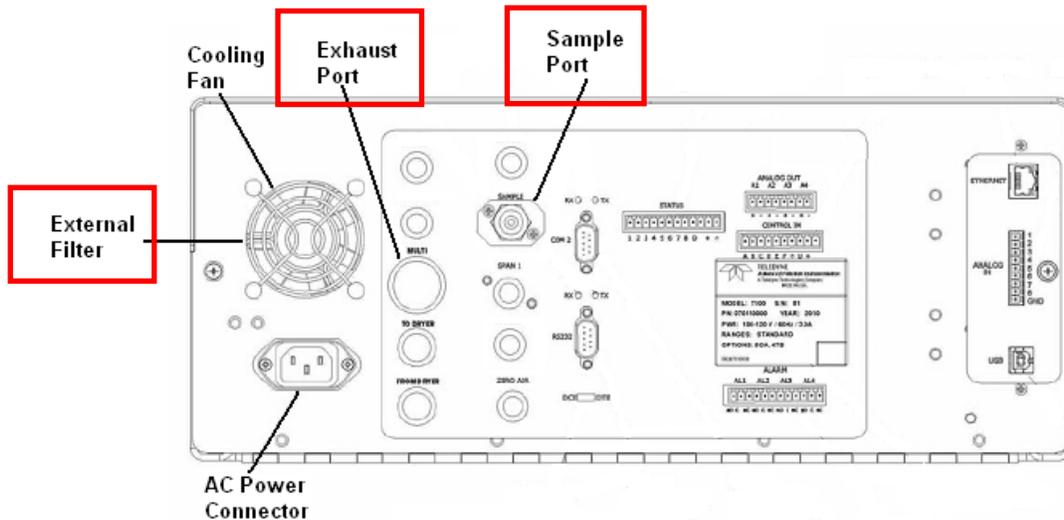
Figure 1   T200UP Rear Panel

2. Open the T200UP's hinged front panel and unscrew the hold down ring on the filter assembly (see **Figure 2** and **Figure 3**).
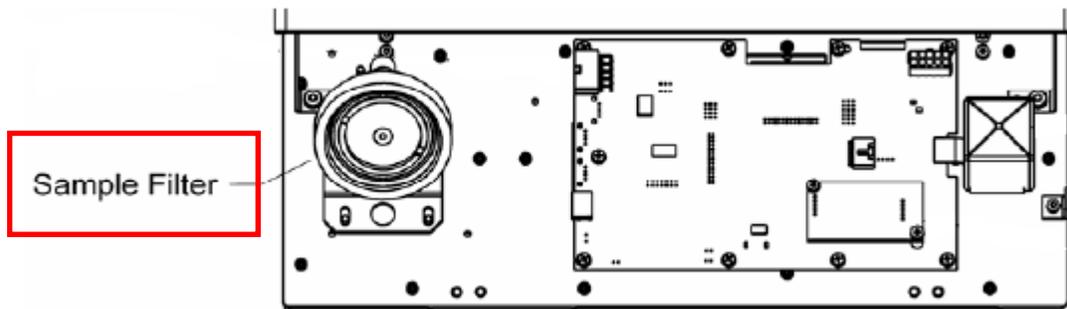
Figure 2   T200UP Hinged Front Panel

3. Carefully remove the hold down ring, glass filter cover, O-ring, PTFE O-ring, and filter element.

4. Replace the filter, being careful that the element is fully seated and centered in the bottom of the holder.

5. Reinstall the PTFE O-ring <u>with the notches up and aligned with the hole</u>. Inspect the seal between the edge of filter and the PTFE O-ring to assure a proper seal. Next install the O-ring, the glass cover, and then screw on the hold down ring, hand tighten.

6. Re-install the exhaust port line to the instrument. The filter does not require conditioning.
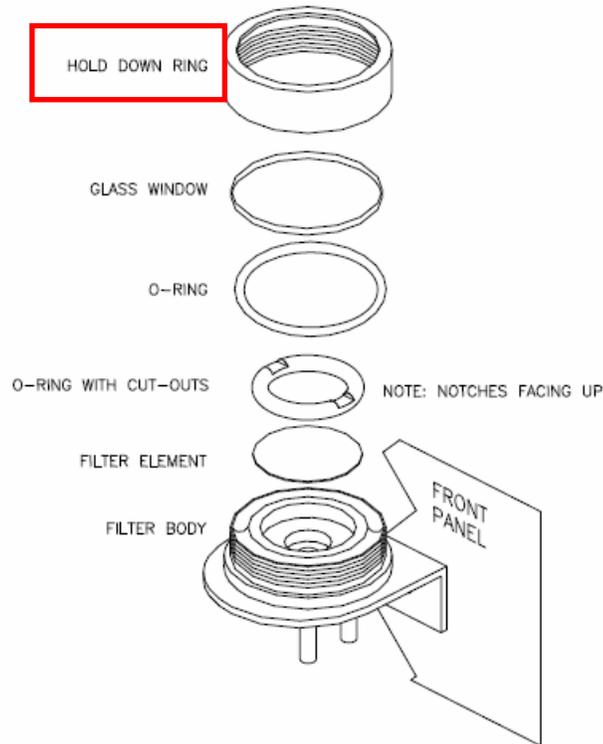
Figure 3   T200UP Particulate Filter Assembly

<u>Leak Check Procedure</u>

1. Remove the top cover and cap the O_3 dryer vent (see Figure 4).
2. Remove the sample line and cap the sample port (see Figure 2). Cap must be wrench tight.
3. After several minutes, note the "RCEL" pressure and the "SAMP" pressure using the "<TST" or "TST>" keys on the T200UP. If both readings are within 0.2 in-Hg-A, the pump is in good condition.
4. Remove the caps and reconnect the sample line, replace the cover
5. Record leak check pass/fail (Y/N) *(e-log, Logbook Tab)*
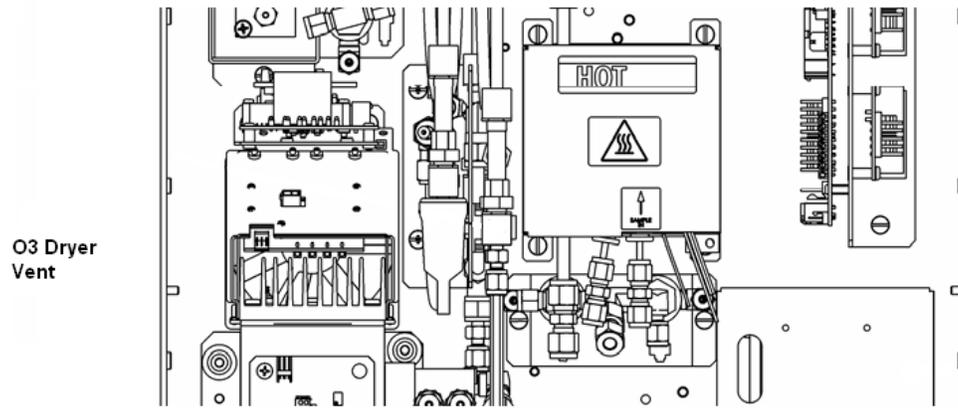
Figure 4   O₃ Dryer Vent

Appendix C: Common Continuous Monitoring Principles Applicable to the NO-NO$_2$-NO$_x$ System

Calibration is required:

- o At the initial start-up of a new site;
- o When the monitor itself is replaced;
- o When the results of two valid PZS results fail to meet warning limits;
- o When the operation of the monitor is interrupted for more than 3 days without power (such as in the case with hurricanes or shelter repairs);
- o If a Multi-Point Calibration Verification fails; and
  - • Every 365 days and once a calendar year

A Multi-Point Calibration Verification is required:

- o As part of any manual calibration procedure
- o Within 182 days of the most recent calibration / calibration verification (regardless of monitor performance) per EPA guidance. See Section 5.2 of this SOP for details.

One-Point QC Check is required:

- o Once every 14-days or less
- o As a final check when a site is shutdown
- o As a check after the operation is restored following a power outage lasting for 3 days or less.

The site Operator can, at his/her discretion, perform a manual performance check, multi-point calibration verification, or calibration at any time he/she feels it is necessary to endure the collection of quality data.

The clock times of the components at the site are to be verified, and if necessary corrected, during each site visit.

During each site visit, the site is to be inspected for general maintenance issues such as condition of the shelter and sample lines as well as the residence time.

Operators are to visit the site once every 14 days

Residence time should be checked during each QC check, calibration verification or calibration.

Appendix D: Force Status Time Instructions

Using Envista Viewer, hover your mouse pointer over one of the table's rows (each row represents a channel) and right click. A menu will appear, as shown below:
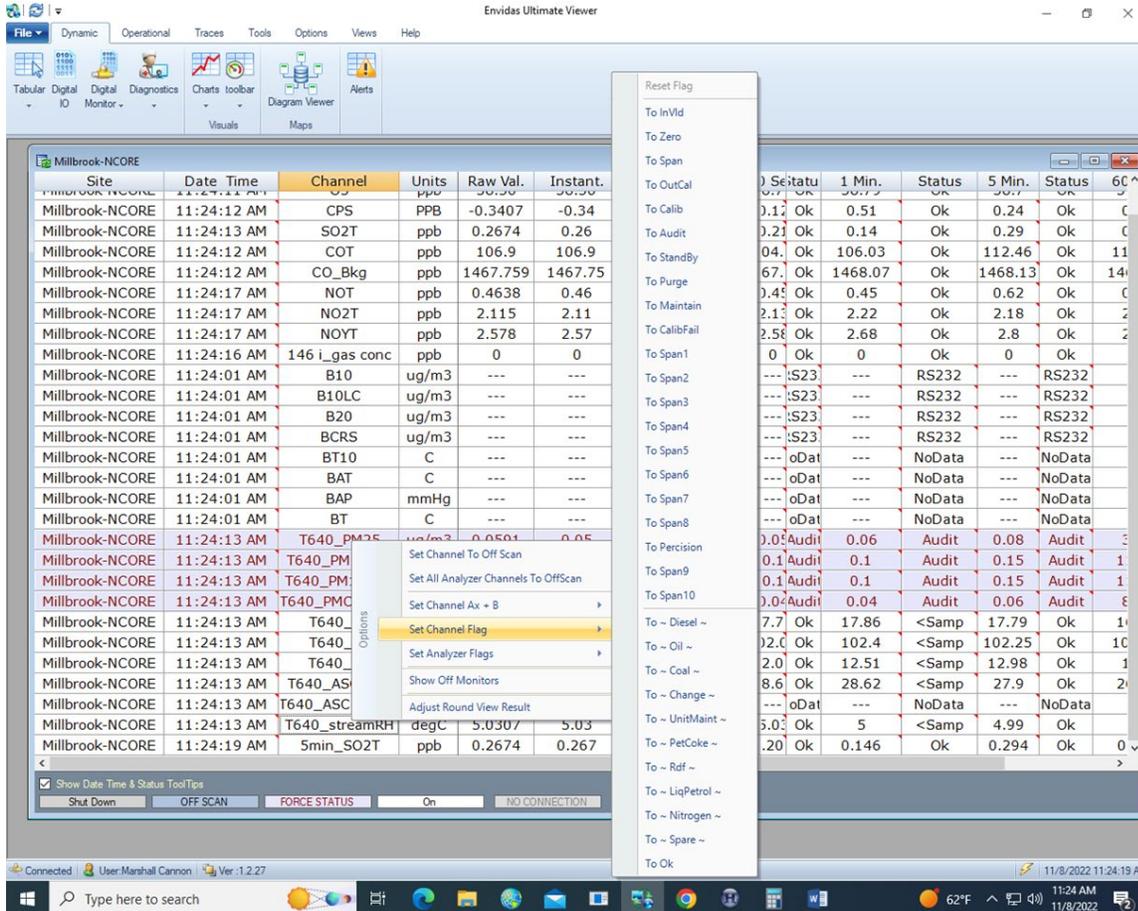
Select Set Channel Flag and select what flag you want ex. "To Maintain." The "Force Status Time" window will appear (See below).

Select "Change Status for" and select how many hours needed to complete the task or procedure scheduled.

Appendix E: Example of e-log

Example of Instructions Tab

INSTRUCTIONS

DAQ-08-002.2   Revision 2.1   January 2023

1) This elog is to be used for NO-NO2-Nox monitors operating in the 500 ppb range

2) Information on "LOGBOOK" Tab is linked to subsequent Tabs as needed.

3) CAL gas and DIL gas flows are obtained from the calibrator as LPM during calibration checks and calibration. Values are recorded in SCCM in the elog. (Convert Liters to SCCM by multiplying LPM * 1000)

4) Fill in the white boxes

5) All cells except [   ] are locked. All [   ] cells require manual entry of information.

6) Back-up records after every site visit. Download from your laptop to a flash drive, a CD, the network or whatever is most reliable for you and yoru region. Let your supervisor/regional chemist know your method of back-up

7) Prepare a NEW e-log for each visit and save the site identifier, pollutant identifier, date and activity.
     (e.g. TO NO2 YYYYMMDD AX)   Codes: BC Multi-Point Calibration
                                              AX Precision/Zero/Span
                                              BA Maintenance/Routine Repairs
                                                  QV Calibration Verification

8) Gas flow and dilution flow values are obtained from the calibrator during calibration and checks

Notes/Comments:

Example of Logbook Tab

LOGBOOK

DAQ-08-002.2   Revision 2.1   January 2023

Site: _____   Date: _____   Time: _____   Operator: _____

Routine Site Inspection | **Building Temperature °C (5.0 - 40.0 °C)** | **Computer / Monitor Time**

Routine Site Inspection		Building Temperature			Computer / Monitor Time	
Building Secure		NIST Thermometer Serial No:		Expiration Date:	**Date (mm/dd/ime (hh:mm)**	
Sample Probe Intact (Y/N)		NIST:		(± 2 °C of NIST?)	NIST:	
Building Power ON (Y/N)		Comet:		OK	Analyzer:	
Safety guardrail intact? (Y/N)	*Triple Oak site only**	HoBo:		OK	Site Computer:	
Site Computer Restarted this Month?		*HoBo Battery > 1 bar?*				

EPA Protocol NO Gas Cylinder

	Cylinder ID				
Nitric Oxide Certified Concentration (ppm)			Cylinder Pressure (psig):		0
Cylinder Expiration Date			Cylinder Delivery Pressure (psig):		Days Remaining

Teledyne Model 701 Zero Air Generator

Serial No. / ID				
Delivery Air Pressure Setpoint (psig):		Expiration Date:	Days Remaining	0

Teledyne Model T700U Calibrator

Serial No. / ID				
		Exp.Date	Days Remaining	0
	Box Temp. *(shelter ±7°C)*		Alarms? (Y/N)	

Teledyne Model T200UP NO-NO2-NOx Analyzer

Serial No.		PMT TEMP (5 ± 2°C)	
INST. RANGE / UNITS 500 ppb (Y/N)		RCEL PRESS (<4 IN-HG-A)	
RCELL TEMP (40 ± 0.1 °C)		SAMP PRESS (Amb ± 1.0 IN-HG-A)	
BOX TEMP (0 - 45°C)		Alarms? (Y/N)	
Sample Line Length (meters)		Residence Time (<20 seconds)	0.00
Sample Flow (990 - 1210 cc/min)		Residence Time (seconds)	#DIV/0!
Date Particulate Filter changed		Leak Check (Pre procedure) within 0.2 in-Hg-A (Y/N)	
		Leak Check (Post procedure) within 0.2 in-Hg-A (Y/N)	

Operator Comments/Notes   * Any damage to the safety guardrail at Triple Oak should be reported to NC DOT, RAMC, RCO and ECB

Level 1 Signoff: _____   Date: _____

Regional Chemist Comments

Level 2 Signoff: _____   Date: _____

Central Office Chemist Comments

Level 3 Signoff: _____   Date: _____

Example of QC Check Tab

14 Day Check
DAQ-08-002.2   Revision 2.1   January 2023

ZERO

T700U Setpoints

CAL (ACT)	0.0	sccm
DIL (ACT)	3000	sccm

T700U Display @ Zero

T700U_ACTCALFLOW		sccm
T700U_ACTDILFLOW		sccm

Section 5.3, Step 1 of SOP

Section 5.3, Step 1 of SOP
REPORTER AVGS.

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
Diff < ± 1.0 p		Diff < ± 1.0 ppb	
	#DIV/0!	#DIV/0!	#DIV/0!

Comments:

SPAN

GPTZ Setpoints

NO	425.0	ppb
O3	405.0	ppb
Ftotal	3000	sccm

GPTZ (SPAN 10)

T700U_ACTCONC	#DIV/0!	ppb
T700U_ACTCALFLOW		sccm
T700U_ACTDILFLOW		sccm
T700U_O3GENFLOW		sccm
DIL (CALC)	0.0	sccm

Section 5.3, Step 2 of SOP
GPTZ 425 ppb NO / 405 ppb O3
REPORTER AVGS. (SPAN 10)

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	#DIV/0!		#DIV/0!
Acceptable	#DIV/0!		#DIV/0!

Section 5.3, Step 4 of SOP
GPT 425 ppb NO / 405 ppb O3
REPORTER AVGS. (SPAN)

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff		#DIV/0!	
Acceptable		#DIV/0!	

Determine the convertor efficiency :

C.E. = [NO2]conv x 100%   NO2 CA= #DIV/0! ppb
         [NO2]Ca   NO2 Conv. #DIV/0! ppb
                                         C.E. = #DIV/0! %
                Where:

[NO2]Ca =([NO]orig-([NO]rem
[NO2]conv = [NO2]Ca - ([NOx]orig - [NOx]rem)

SPAN 1

GPTZ Setpoints

NO	65.0	ppb
O3	45.0	ppb
Ftotal	3000	sccm

GPTZ (SPAN 3)

T700U_ACTCONC	#DIV/0!	ppb
T700U_ACTCALFLOW		sccm
T700U_ACTDILFLOW		sccm
T700U_O3GENFLOW		sccm
DIL (CALC)	0.0	sccm

Section 5.3, Step 5 of SOP
GPTZ 65 ppb NO / 45 ppb O3
REPORTER AVGS. (SPAN 3)

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	#DIV/0!		#DIV/0!
Acceptable	#DIV/0!		#DIV/0!

Section 5.3, Step 7 of SOP
GPT 65 ppb NO / 45 ppb O3
REPORTER AVGS. (SPAN 1)

Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff		#DIV/0!	
Acceptable		#DIV/0!	

Determine the convertor efficiency :

C.E. = [NO2]conv x 100%   NO2 CA= #DIV/0! ppb
         [NO2]Ca   NO2 Conv. #DIV/0! ppb
                                         C.E. = #DIV/0! %
                Where:

[NO2]Ca =([NO]orig-([NO]rem
[NO2]conv = [NO2]Ca - ([NOx]orig - [NOx]rem)

Example of Min Data (QC Check) Tab

Minute Data												
DAQ-08-002.2 Revision 2.1 January 2023												

Example of Calibration Tab

Calibration

DAQ-08-002.2   Revision 2.1   January 2023

Site: 0   Date: 1/0/00   Time: 0:00   Operator: 0

Instrument Settings / *Pre-Calibration*

| | NOx Slope | | NO Slope | | SET A CE Gain | |
| NOx Offset | | NO Offset | | SET B CE Gain | |

Cylinder NO Conc: 0.00

	Flow Rate (sccm) (DIL)	Flow Rate (sccm) (CAL)	T700U NOx ppb	T700U NO ppb
Zero			#DIV/0!	#DIV/0!
Span			#DIV/0!	#DIV/0!

ZERO Calibration
Section 5.1.1 of SOP

ZERO	Monitor Values		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

Acceptable: (diff ± 1 ppb) | #DIV/0! | #DIV/0! | #DIV/0! |

DIL PRES ____
(record from Calibrator during ZERO)

CAL PRES ____
(record from Calibrator during SPAN)

(DIL and CAL PRES should match ZAG pressure and Cylinder Delivery Pressure ± 1 psig)

SPAN Calibration
Section 5.1.2, Step 7 of SOP

Span	Monitor Values		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
% Diff	#DIV/0!		#DIV/0!

Acceptable: [diff ± 3%] | #DIV/0! | | #DIV/0! |

TITRATION / CALIBRATION

Section 5.1.3.1 of SOP
80-90% FS GPTZ Titration "CALB"

GPTZ Setpoints		
NO	425	ppb
O3	405	ppb
Flow total	3000	sccm

	Monitor Values		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

Section 5.1.3.3 of SOP
80-90% FS GPT "CALB"

	Monitor Values		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

GPTZ (NO) | #DIV/0! | ppb
GPT (NO) | #DIV/0! | ppb
→ NO2B (O3) | #DIV/0! | ppb

After Adj. Converter Efficiency
SET B Gain ____
Section 5.1.3.4 of SOP

Section 5.1.3.5 of SOP
10-20% FS GPTZ Titration "CALA"

GPTZ Setpoints		
NO	65	ppb
O3	45	ppb
Flow total	3000	sccm

	Monitor Values		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

Section 5.1.3.7 of SOP
10-20% FS GPT "CALA"

	Monitor Values		
Hrs:min	NO ppb	NO2 ppb	NOx ppb
Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!

GPTZ (NO) | #DIV/0! | ppb
GPT (NO) | #DIV/0! | ppb
→ NO2A (O3) | #DIV/0! | ppb

After Adj. Converter Efficiency
SET A Gain ____
Section 5.1.3.8 of SOP

Instrument Settings / *Post-Calibration*

| | NOx Slope | | NO Slope | | SET A CE Gain | 0.0000 |
| NOx Offset | | NO Offset | | SET B CE Gain | 0.0000 |

Slope values must be between -0.700 to 1.3, if not notify ECB.   Offset values must be between -20.0 to 150.0, if not notify ECB.

Comments:

Example of GPT Worksheet Tab

GPT Work Sheet
DAQ-08-002.2   Revision 2.1   January 2023

ZERO

T700U Setpoints			REPORTER AVGS. (ZERO)				Comments:
CAL (ACT)	0.0	sccm	Hrs:min	NO ppb	NO2 ppb	NOx ppb	
DIL (ACT)	3000	sccm					
T700U Display @ Zero							
T700U_ACTCALFLOW	0.0	sccm					
T700U_ACTDILFLOW	3000	sccm					
			Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!	

GAS PHASE TITRATION (NO2 E-LOG) T200VER1

GPTZ Setpoints			GPTZ 425 ppb NO / 405 ppb O3 REPORTER AVGS. (SPAN 10)				GPT 425 ppb NO / 405 ppb O3 REPORTER AVGS. (SPAN)			
NO	425.0	ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb
O3	405.0	ppb								
Ftotal	3000	sccm								
GPTZ (SPAN 10)										
T700U_ACTCONC	#DIV/0!	ppb								
T700U_ACTCALFLOW		sccm								
T700U_ACTDILFLOW		sccm								
T700U_O3GENFLOW		sccm	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
DIL (CALC)	0.0	sccm								

GPTZ Setpoints			GPTZ 305 ppb NO / 285 ppb O3 REPORTER AVGS. (SPAN 8)				GPT 305 ppb NO / 285 ppb O3 REPORTER AVGS. (SPAN 6)			
NO	305.0	ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb
O3	285.0	ppb								
Ftotal	3000	sccm								
GPTZ (Span 8)										
T700U_ACTCONC	#DIV/0!	ppb								
T700U_ACTCALFLOW		sccm								
T700U_ACTDILFLOW		sccm								
T700U_O3GENFLOW		sccm	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
DIL (CALC)	0.0	sccm								

GAS PHASE TITRATION (NO2 E-LOG) T200VER2

GPTZ Setpoints			GPTZ 185 ppb NO / 165 ppb O3 REPORTER AVGS. (SPAN 6)				GPT 185 ppb NO / 165 ppb O3 REPORTER AVGS. (SPAN 4)			
NO	185.0	ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb
O3	165.0	ppb								
Ftotal	3000	sccm								
GPTZ (SPAN 6)										
T700U_ACTCONC	#DIV/0!	ppb								
T700U_ACTCALFLOW		sccm								
T700U_ACTDILFLOW		sccm								
T700U_O3GENFLOW		sccm	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
DIL (CALC)	0.0	sccm								

GPTZ Setpoints			GPTZ 65 ppb NO / 45 ppb O3 REPORTER AVGS. (SPAN 3)				GPT 65 ppb NO / 45 ppb O3 REPORTER AVGS. (SPAN 1)			
NO	65.0	ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb	Hrs:min	NO ppb	NO2 ppb	NOx ppb
O3	45.0	ppb								
Ftotal	3000	sccm								
GPTZ (SPAN 3)										
T700U_ACTCONC	#DIV/0!	ppb								
T700U_ACTCALFLOW		sccm								
T700U_ACTDILFLOW		sccm								
T700U_O3GENFLOW		sccm	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!	Avg ppb	#DIV/0!	#DIV/0!	#DIV/0!
DIL (CALC)	0.0	sccm								

Example of Calibration Verification Summary Tab

Calibration Summary
DAQ-08-002.2 Revision 2.1 January 2023

NO	r	slope (m_i)	intcpt (I_i)	lin reg
	#####	#####	#####	#####
Best Fit Concentration	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute value	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc vs. Avg Y values)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

NO$_2$	r	slope (m_i)	intcpt (I_i)	lin reg
	#####	#####	#####	#####
Best Fit Concentration	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute value	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc vs. Avg Y values)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

NOx	r	slope (m_i)	intcpt (I_i)	lin reg
	#####	#####	#####	#####
Best Fit Concentration	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute value	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc vs. Avg Y values)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

NOx Slope	0.0	NOx Offset	0.000
NO Slope	0.0	NO Offset	0.000
SET A CE Gain	0	SET B CE Gain	0

Slope values must be between -0.700 to 1.0 ± 0.3, if not notify ECB.
Offset values must be between -20.0 to 150.0, if not notify ECB.

Calibration completed on:	January 0, 1900

Example of Verification Tab

Verification

DAQ-08-006.2 · Revision 2.1 · January 2023

Panel (top row — four small blocks, repeated below at larger size)

ZERO FLOW : 0.0   **GAS FLOW :** 0.00

GPTZ 425 ppb NO / 405 ppb O3   **GPT 425 ppb NO / 405 ppb O3**
GPTZ   GPT
ORIGINAL   (CM)   REMAINDER   (CM)

	NO	NOx			NO	NOx
1	0.00	0.00		1	0.00	0.00
2	0.00	0.00		2	0.00	0.00
3	0.00	0.00		3	0.00	0.00
4	0.00	0.00		4	0.00	0.00
5	0.00	0.00		5	0.00	0.00
AVG	0.00	0.00		AVG	0.00	0.00

CONVERTOR EFFICIENCY : #DIV/0! %

Determine the convertor efficiency :

C.E. = $\frac{[NO2]conv}{[NO2]Ca}$ x 100%   NO2 CA= 0.0 ppb
NO2 Conv. 0.0 ppb
C.E. = #DIV/0! %
Where:

[NO2]Ca =([NO]orig-([NO]rem)
[NO2]conv = [NO2]Ca - ([NOx]orig - [NOx]rem)

ZERO FLOW : 0.0   **GAS FLOW :** 0.00

GPTZ 305 ppb NO / 285 ppb O3   **GPT 305 ppb NO / 285 ppb O3**
GPTZ   GPT
ORIGINAL   (CM)   REMAINDER   (CM)

	NO	NOx			NO	NOx
1	0.00	0.00		1	0.00	0.00
2	0.00	0.00		2	0.00	0.00
3	0.00	0.00		3	0.00	0.00
4	0.00	0.00		4	0.00	0.00
5	0.00	0.00		5	0.00	0.00
AVG	0.00	0.00		AVG	0.00	0.00

CONVERTOR EFFICIENCY : #DIV/0! %

Determine the convertor efficiency :

C.E. = $\frac{[NO2]conv}{[NO2]Ca}$ x 100%   NO2 CA= 0.0 ppb
NO2 Conv. 0.0 ppb
C.E. = #DIV/0! %
Where:

[NO2]Ca =([NO]orig-([NO]rem)
[NO2]conv = [NO2]Ca - ([NOx]orig - [NOx]rem)

ZERO FLOW : 0.0   **GAS FLOW :** 0.00

GPTZ 185 ppb NO / 165 ppb O3   **GPT 185 ppb NO / 165 ppb O3**
GPTZ   GPT
ORIGINAL   (CM)   REMAINDER   (CM)

	NO	NOx			NO	NOx
1	0.00	0.00		1	0.00	0.00
2	0.00	0.00		2	0.00	0.00
3	0.00	0.00		3	0.00	0.00
4	0.00	0.00		4	0.00	0.00
5	0.00	0.00		5	0.00	0.00
AVG	0.00	0.00		AVG	0.00	0.00

CONVERTOR EFFICIENCY : #DIV/0! %

Determine the convertor efficiency :

C.E. = $\frac{[NO2]conv}{[NO2]Ca}$ x 100%   NO2 CA= 0.0 ppb
NO2 Conv. 0.0 ppb
C.E. = #DIV/0! %
Where:

[NO2]Ca =([NO]orig-([NO]rem)
[NO2]conv = [NO2]Ca - ([NOx]orig - [NOx]rem)

ZERO FLOW : 0.0   **GAS FLOW :** 0.00

GPTZ 65 ppb NO / 45 ppb O3   **GPT 65 ppb NO / 45 ppb O3**
GPTZ   GPT
ORIGINAL   (CM)   REMAINDER   (CM)

	NO	NOx			NO	NOx
1	0.00	0.00		1	0.00	0.00
2	0.00	0.00		2	0.00	0.00
3	0.00	0.00		3	0.00	0.00
4	0.00	0.00		4	0.00	0.00
5	0.00	0.00		5	0.00	0.00
AVG	0.00	0.00		AVG	0.00	0.00

CONVERTOR EFFICIENCY : #DIV/0! %

Determine the convertor efficiency :

C.E. = $\frac{[NO2]conv}{[NO2]Ca}$ x 100%   NO2 CA= 0.0 ppb
NO2 Conv. 0.0 ppb
C.E. = #DIV/0! %
Where:

[NO2]Ca =([NO]orig-([NO]rem)
[NO2]conv = [NO2]Ca - ([NOx]orig - [NOx]rem)

Example of NO Regression Tab

NO Linear Regression

Instructions
1) Place in the acceptable percentage (2% is current validation criteria) in D6
2) Select the calibration scale. This does not need to be the FEM approved scale of the instrument (e.g., 500 ppb or 1000 ppb) in D7.
   It should be the high cal value. The point difference acceptance value in field D8 will be calculated for the values entered in D6 and D7
3) Calibration values (X) in Row 18 are linked to the Calibrator minute values entered on the GPT Worksheet Tab
4) Instrument values (Y) are linked to the Analyzer minute values entered on the GPT Worksheet Tab.
5) The remainder of the worksheet should automatically calculate the results.
6) Any **point result >** the point difference acceptance criteria in D8 will turn the boxes and font in rows 27 red.
   Any **percent difference >** the value in D6 will turn the boxes and font in rows 28 red.
7) The percent difference estimates are measured using the best fit conc. values (row 26)
   and the average of the instrument avg. values (row 24) for each concentration.
   Acceptance Criteria: all points within D6 % of best fit straight line

What percentage is acceptable?	2%
Calibration Scale	425
Point Difference Acceptance Value	2
Slope Acceptance Criteria	0.95 - 1.05

Only values on sheet that can be changed are in gray, above

	Zero	SPAN (~425 ppb)	SPAN 6 (~305 ppb)	SPAN 4 (~185 ppb)	SPAN 1 (~65 ppb)
Calibrator Value (X)	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Instrument Value (Y)	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00
Instrument Average	0.00	0.00	0.00	0.00	0.00

Best Fit Concentration		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute value		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc. vs. Avg Y values)		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

r	slope (m$_i$)	intcpt (I$_i$)	lin reg
#DIV/0!	#DIV/0!	#DIV/0!	#VALUE!

(Calibrator) X	(Monitor) Y
0.0	0.00
#DIV/0!	0.00
#DIV/0!	0.00
#DIV/0!	0.00
#DIV/0!	0.00

NO Regression

Example of NO$_2$ Regression Tab

NO$_2$ Linear Regression

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		Instructions
What percentage is acceptable?	2%	1) Place in the acceptable percentage (2% is current validation criteria) in D6
Calibration Scale	425	2) Select the calibration scale. This does not need to be the FEM approved scale of the instrument (e.g., 500 ppb or 1000 ppb) in D7.
Point Difference Acceptance Value	2	It should be the high cal value. The point difference acceptance value in field D8 will be calculated for the values entered in D6 and D7
Slope Acceptance Criteria	0.95 - 1.05	3) Calibration values (X) in Row 18 are linked to the Calibrator minute values entered on the GPT Worksheet Tab
		4) Instrument values (Y) are linked to the Analyzer minute values entered on the GPT Worksheet Tab.
		5) The remainder of the worksheet should automatically calculate the results.
Only values on sheet that can be		6) Any **point result >** the point difference acceptance criteria in D8 will turn the boxes and font in rows 27 red.
changed are in gray, above		Any **percent difference >** the value in D6 will turn the boxes and font in rows 28 red.
		7) The percent difference estimates are measured using the best fit conc. values (row 26)
		and the average of the instrument avg. values (row 24) for each concentration.
		Acceptance Criteria: all points within D6 % of best fit straight line

	Zero	SPAN (~405 ppb)	SPAN 6 (~285 ppb)	SPAN 4 (~165 ppb)	SPAN 1 (~45 ppb)	
Calibrator Value (X)	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	*Calibrator X value used is the average NO value during GPTZ*
	0.00	0.00	0.00	0.00	0.00	*minus the average NO value from the GPT Worksheet*
	0.00	0.00	0.00	0.00	0.00	
Instrument Value (Y)	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	
Instrument Average	0.00	0.00	0.00	0.00	0.00	

Best Fit Concentration	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute value	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc vs. Avg Y values)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

r	slope (m$_i$)	intcpt (I$_i$)	lin reg
#DIV/0!	#DIV/0!	#DIV/0!	#VALUE!

(Calibrator) X	(Monitor) Y
0.0	0.00
#DIV/0!	0.00
#DIV/0!	0.00
#DIV/0!	0.00
#DIV/0!	0.00

NO2 Regression

(Chart: Instrument Reading (Y) axis from 0 to 500, Calibration Values (X) axis from 0 to 1)

Example of NO$_x$ Linear Regression Tab

NOx Linear Regression
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What percentage is acceptable?	2%
Calibration Scale	425
Point Difference Acceptance Value	2
Slope Acceptance Criteria	0.95 - 1.05

Only values on sheet that can be changed are in gray, above

Instructions

1) Place in the acceptable percentage (2% is current validation criteria) in D6
2) Select the calibration scale. This does not need to be the FEM approved scale of the instrument (e.g., 500 ppb or 1000 ppb) in D7.
   It should be the high cal value. The point difference acceptance value in field D8 will be calculated for the values entered in D6 and D7
3) Calibration values (X) in Row 18 are linked to the Calibrator minute values entered on the GPT Worksheet Tab
4) Instrument values (Y) are linked to the Analyzer minute values entered on the GPT Worksheet Tab.
5) The remainder of the worksheet should automatically calculate the results.
6) Any **point result >** the point difference acceptance criteria in D8 will turn the boxes and font in rows 27 red.
   Any **percent difference >** the value in D6 will turn the boxes and font in rows 28 red.
7) The percent difference estimates are measured using the best fit conc. values (row 26)
   and the average of the instrument avg. values (row 24) for each concentration.
   Acceptance Criteria: all points within D6 % of best fit straight line

	Zero	SPAN (~425 ppb)	SPAN 6 (~305 ppb)	SPAN 4 (~185 ppb)	SPAN 1 (~65 ppb)
Calibrator Value (X)	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	0.00				
	0.00				
Instrument Value (Y)	0.00				
	0.00				
	0.00				
Instrument Average	0.00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Best Fit Concentration		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Point Difference (Best fit - Average) absolute value		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Percent Difference (Best fit Conc. vs. Avg Y values)		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

r	slope (m$_i$)	intcpt (I$_i$)	lin reg
#DIV/0!	#DIV/0!	#DIV/0!	#VALUE!

(Calibrator) X	(Monitor) Y
0.0	0.00
#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!

Example of Minute Data (T200VER1) Tab

Minute Data (T200VER1)
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Example of Minute Data (T200VER2) Tab

Minute Data (T200VER2)
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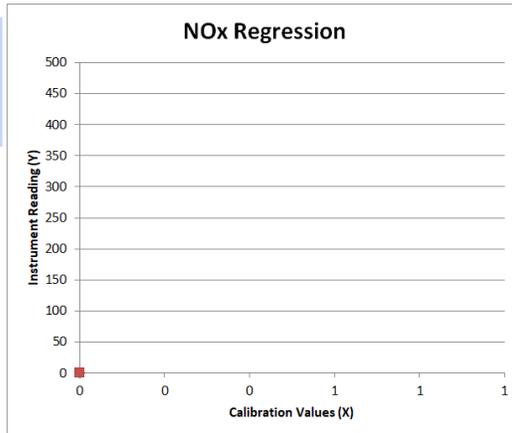
Example of Graph Tab

Graphs
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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 three upscale points. One of the upscale points must be at the detection limit of the instrument. Another 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 e-log, 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 <u>both</u> 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 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.

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 intermediate, equally spaced concentrations to verify the linearity of the calibration and assess the overall success of the calibration. A multi-point verification may be used instead of a calibration for carbon monoxide and other pollutants, 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 SO_2 and O_3 the data for a failed PZS are reported to AQS. The data are invalidated back to the last passing PZS. The operator is required to take corrective action. Valid data cannot be reported until the problem is corrected, or the instrument is recalibrated.

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

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

Start-up – is when the monitor is now collecting reportable data.

Systems Test – is a test of the monitor, calibrator, cylinder, zero air supply, or other support equipment conducted by an operator, either remotely or on site, to evaluate whether the system is performing as expected. It may include, but is not limited to, running a zero and span or multiple points. Since systems tests involving the running of points do not necessarily run the points long enough for them to stabilize, results of systems tests are not reported to AQS. Systems tests must be recorded in an e-log and, alone, cannot be used as weight of evidence to demonstrate that the monitor is functioning properly.

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 e-log, 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".