

Trace Level Carbon Monoxide (TEI – 48S) QA Plan
Section II

Operators Responsibilities

Table of Contents

2.16.2	HSCO Monitoring Site Operation Procedures.....	3
2.16.2.1	Procedures for Site Operation and Calibration for High Sensitivity Carbon Monoxide (CO) Monitors	3
2.16.2.2	CALIBRATION	5
A)	Operational Checks for HSCO Monitoring Sites.....	5
B)	Filter Change Procedure	9
C)	Model 48S Leak Check.....	9
D)	Zero (Ø) Calibration	10
E)	Multi-Point Procedure.....	12
2.16.2.3	CALIBRATION CHECK.....	13
A)	Operational Checks.....	13
B)	Calibration Check Procedure	18
C)	Zero (Ø) Calibration Check Procedure	19
D)	Span Calibration Check Procedure	20
E)	Filter Change Procedure	21
F)	Model 48S Leak Check.....	21
2.16.2.4	Review Calibration and End	22
2.16.2.5	Site Calls	23
2.16.2.6	Data Reporting and Validation for Regional Offices	24
2.16.2.7	Quality Assurance Procedures	25
2.16.2.8	Monitor Shutdown Procedure	26

2.16.2 HSCO Monitoring Site Operation Procedures

2.16.2.1 Procedures for Site Operation and Calibration for High Sensitivity Carbon Monoxide (CO) Monitors

The U.S. EPA is currently implementing the National Ambient Air Monitoring Strategy (NAAMS). The NAAMS goals include improvement of the scientific and technical competency of the nation's air monitoring networks and increased value in protecting public health and the environment. One of the major areas of investment in the NAAMS is the use of highly sensitive commercial air pollutant monitors for the characterization of the precursor gas CO. A modification was instituted to increase the range from 2 ppm to 5 ppm to improve sensitivity and accuracy or reduce interferences. This revision reflects changes to calibration, calibration check and audit procedures as per NAAMS and Code of Federal Regulations 40CFR 58 promulgated October 17, 2006.

The Division of Air Quality of the Department of Environment and Natural Resources determines the ground level concentration of ambient air ozone and fine particulate matter throughout North Carolina as required by the 1970 Clean Air Act and the subsequent amendments thereto. In short, the Clean Air Act established ambient air quality as a national resource that must be protected. The EPA is designated the responsibility to administer and assist in the nationwide program to protect and improve air quality and each state is assigned the direct responsibility for assuring air quality within its borders. Besides being one of the "Health and Welfare" based Criteria Pollutants required to be monitored by each state as a means of tracking progress in improving and maintaining ambient air quality, Carbon Monoxide is also a precursor to ozone and particulate matter.

The State of North Carolina operates Trace Level Carbon Monoxide (HSCO) monitors across the state. In order to collect accurate, meaningful data the monitors must be operated in a consistent manner. Trace Level Carbon Monoxide monitoring is conducted at two or three sites from May to September to support ozone precursor monitoring and two sites year round to support fine particle precursor monitoring. The goal of this document is to establishing a continuous, verifiable, defensible record of events with regard to the site and the instrument.

All original records (records documenting observations, i.e. calibration logbook and site logbook) must be legible, complete, dated, and signed by the operator and retained as part of the permanent analyzer calibration record. The operator's signature on the calibration logbook form certifies that the calibration has been performed in accordance with this QA/SOP and that the information contained on the form is accurate. All records will be reviewed and verified by the Regional Chemist and audited by Raleigh Headquarters.

A. Continuous monitoring principles that apply to the HSCO system:

- Data Backup

- Do not perform checks or calibrations between 6:00 AM and 9:00AM "Local Standard Time"
- Calibration Checks:
 - Performed every 14 days before filter changes and instrument leak checks.
 - Performed every 14 days – PRECISION CHECK
 - Performed following minor repairs that should not affect the calibration of the analyzer: *coalesce* change, inlet sample line replacement, and particulate filter change.
 - When the 146C calibrator and/or gas cylinders are changed out (if not done because of a problem), the operator should perform a calibration check before the items are changed out. After the new calibrator has had 24 hours to stabilize, the operator should perform a calibration check. A Calibration check should be performed to evaluate the new/replacement calibrator or cylinder. If the calibration check passes then a Calibration must be performed. If the calibration check fails there has to be a thorough evaluation of why it failed but the existing monitor, which is still within an acceptable calibration and operational control, should not be changed.
 - Perform Calibration if K_1 (drift) > 200 ppb and / or Zero > 75 ppb.
- Calibration:
 - An initial, manual, Calibration must be performed during the site start-up.
 - Performed at season startup without performing a Calibration Check.
 - Performed after interruption of analyzer operation for 2 days or more.
 - Performed with any physical relocation of analyzer.
 - Performed when a Calibration Check does not meet QA criteria.
 - Performed with any repair that might affect the instrument calibration (analyzer, calibrator or calibrator gas change).
 - Performed every 90 days

B. Equipment:

- TEI/TECO Model 48S CO Analyzer
- TEI 146C Dynamic Gas Calibrator
- Model 111 Zero Air Supply System
- ESC 8816 Data Logger: primary (PDL) & backup (BUDL)
- Optional Components: Uninterruptible Power Supply (UPS) is recommended if you autopolll your monitors at scheduled times
- Dedicated site PC
- Telephone modem
- Air compressor

C. Safety Issues and Concerns

- A gas cylinder of 70-ppm carbon monoxide is used as calibration standard. Certain safety precautions are required due to the nature of this gas. Carbon Monoxide (CO) is an odorless, colorless, poisonous gas. Carbon Monoxide enters the bloodstream through the lungs and attaches to red blood cells. CO molecules prevent the flow of oxygen to the heart, brain, and vital organs. As CO accumulates in the bloodstream the body becomes starved for oxygen.
- **Breathing high concentrations of CO can be lethal in minutes. Low concentrations over time can be dangerous as well.**
- **Early symptoms of carbon monoxide poisoning include headache, dizziness, weakness, nausea, vomiting, sleepiness, and confusion.**

2.16.2.2 CALIBRATION

A) Operational Checks for HSCO Monitoring Sites

1) Site Checks

Upon arrival at the site, observe the outside of the sampling building and probe, looking for vandalism or security breaches. If there is any evidence of vandalism contact the appropriate law enforcement department (generally this is the city police department if the monitor is within city limits, and the county sheriff's department if outside city limits) and headquarters. Record your observations in the logbooks and **do not make any adjustments to the front panel controls during these checks.** Except for particulate filter changes, phone ECB (Electronics and Calibration Unit) for guidance before making any adjustments to the front panel controls.

Inspect the Inverted Funnel, Wire Screen, Sample Probe Line, and Calibration

Line: visually inspect and document the condition of the sample delivery and calibration tubing systems. This inspection should also be performed during each site visit. The probe should be turned down, an undamaged inverted funnel on the end, the wire screen must be in place to protect the sampling probe from insects and foreign material, and the Teflon line must be visible inside the funnel screen.

Power On and Sample Line Check: observe the analyzer, calibrator, computer, and data loggers for indications of power failure, and if needed, correct the cause. Verify the instrument "**POWER**" light is lit and there is an audible sound from the external pump. If the analyzer or calibrator lost power, allow an equilibration period of at least an hour for the instrument(s) to stabilize. Visually inspect the tubing, especially at any bends, to ensure that it has not been accidentally kinked, crimped, cut, or insects are nested in the lines. Particulate matter may also load the sample line ahead of the inlet filter. Such restrictions can usually be determined by disconnecting the inlet line of the sample pump. If pump performance is significantly improved and the inlet filter itself is not loaded with particulate matter, the sample line may require replacement. Record all events in

logbook. Notify supervisor and call the ECB for instructions on length of stabilization period and recycling the data logger if necessary.

Check on Gas Cylinder and 146C Calibrator: verify the gas cylinder and calibrator are in certification (calibrator certification sticker on front panel) and document certification dates in logbook. (If the cylinder pressure is less than 500 psig arrange with ECB when the Region will do a calibration check before delivery of the cylinder. Calibrate after the new cylinder is installed per 2.16.2.2. Verify that the 146C has the correct cylinder concentration stored in memory.

146C Calibrator

- Main Menu
- Gas A, <ENTER>
- Tank Conc, <ENTER>

Range Check: verify that the range switch is at the correct setting of 5 ppm for CO engagement of the STAT pushbutton #2 option. If the range has been changed, determine when and by whom. Invalidate all data in the wrong range. Notify supervisor and Quality Assurance Coordinator immediately, conduct a calibration check, re-enter the range to the correct entry, then recalibrate.

Time Switch Settings – Press STAT three times for **time**. Verify that the **time switch** is set to **22**.

Station Temperature Check: measure and record the site temperature in °C. Adjust the site thermostats as necessary to maintain the 20° to 30°C range. If the temperature is outside of the 20° to 30°C range, notify the Regional Chemist and the ECB to correct the problem and invalidate data if necessary.

Detector Frequency Check: check the infrared light intensity in Hz by pressing the INT button once, record the reading, press again, and record the reading. Both readings should be at least 10,000 Hz. If not, call the ECB. (**Note: If greater than 30,000 Hz, call ECB**)

Pressure/Temperature Check: check the pressure transducer by pressing the P/T button once and record the reading. The display should agree with the ambient pressure by **±10 mm Hg**. If not, check the particulate filter for dirt loading and replace as necessary. Replace and tighten cover, again ensuring that the O-ring seal is aligned. If the value still disagrees with the ambient pressure, call the ECB. Check the temperature transducer in degrees C by pressing the P/T button again. The display should read between **31°** and **40°C**. If the readings are not in this range, call the ECB.

Model 111 Zero Air Pak and Compressor Checks: the silica gel in the cartridges located on the back of the Zero Air Pak removes the moisture from the compressed air before the carbon monoxide is removed from the dried air by the internal carulite

canister. Silica gel, though, has a limited capacity to effectively remove moisture from the air stream. Because of this limited capacity, the silica gel must be replaced every 14 days or less to insure effective moisture removal in both cartridges. Verify that the silica gel is not spent by color change. When the gel is new it is a dark blue in color. If the gel is spent, it is a lighter blue in color with white crystals. If the gel is spent or it has been 14 days since it was last changed, replace it, and return it to the ECB for regeneration. Check the condition of the Purifill. Fresh Purifill is purple and turns brown when saturated. Replace when purple color is less than 20% of the volume. Remove the cartridge holding the Purifill, unscrew the cap, discard used Purifill, replace with fresh and screw on the cap and replace cartridge. Record in logbook. On an annual basis, change all scrubbing medium.

Verify and record that the outlet pressure on the air compressor is reading between 40 and 50 psi. Verify and record that the ZAP is reading between 20 and 40 psi. If either pressure reading is outside of these ranges, contact the ECB and record corrective action. Also, check and drain any water from the compressor (do this at every site visit). Document this activity in the logbook.

2) **TEI 48S Analyzer and 146C Calibrator Alarm and Operational Checks**

Basic checks of the instrumentation.

Alarm Check (146C Calibrator)

Check the TEI 146C Run Screen

- a. Press the <MENU> button on the front of the instrument. (Make sure the 146C is in "**Remote**" mode, the 146C has to be in the REMOTE MODE in order to activate the internal span solenoid inside the 48S)

Check for "**Alarm**" on the displays. If no alarms are present, record the "Alarm On" checks in the logbook as "**no**" and continue. If either screen shows an alarm, record the "Alarm On" check as "**yes**" in the logbook for the appropriate instrument/s. View the Alarm menu to determine the cause:

- b. Use the ↑ or ↓ menu pushbuttons to select the **Alarm Submenu**, <ENTER>
- c. Use the ↑ or ↓ menu pushbuttons to select the item that is in Alarm Status.
NOTE: Items that are not in alarm status are labeled "OK", <ENTER>
- d. Determine the cause of the alarm. Consult with the ECB prior to performing calibrations or maintenance.
- e. Press the <MENU> button twice to return to the main menu screen.

The following Alarm Limit is used in the CO operation of the TEI 146C Calibrators:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Internal Temperature	18.5°C	47°C

TEI 48S Analyzer Checks

The following Test mode parameter ranges are allowed in the TEI 48S Analyzer:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Flow (rotameter)	0.5 LPM	2.0 LPM
Lamp Intensity (1 & 2)	10,000 Hz	30,000 Hz
Fscale (Stat)	0 ppm	5 ppm
CO Analytical Range	0 ppm	5 ppm
Sample Temperature	~ ambient	
Pressure	~760 mmHg	

Operational Checks (48S Analyzer and 146C Calibrator)

Cooling Fan Filter Check: on the back of the instruments there are cooling fans with sponge filters inside. Check to ensure the fans are running. Check to see if the filters are clean monthly. The fan housing can be popped off the back of the instrument and the filter may be removed and cleaned if necessary (either by rubbing with a cloth or between your hands to remove any dust or with compressed air). After cleaning, replace the filter and the housing. Record in the logbook.

Maintenance and Troubleshooting Documentation: any other suspected mechanical problems see Section 2.16.1 (ECB) for Preventative and Routine Maintenance for Troubleshooting. Document all of the above in the logbook.

3) Setting computer, PDL, and BUDL time/date.

The times for the PDL, BUDL, and computer must be EASTERN STANDARD TIME.

NOTE!! The BUDL and PDL must have the same NIST time ± 1 minute; the computer time must be 5 minutes slower than the PDL/BUDL time.

Sources for getting the correct time:

1. Call the ECB and ask for the NIST time.
2. Call the NIST Colorado time @ **(303) 499-7111** (long distance).
3. Correct time loaded into cell phone.
4. Correct time website, <http://nist.time.gov/>.

Check the computer time and date at the lower right hand corner of the computer screen. If the time and date are not correct; click START button, control panel, date/time or right click computer time on taskbar, select " **Adjust Date/Time**, type in changes and select "OK ".

PDL & BUDL time and date:

- Double click 'Shortcut to Splitscreen'
- PDL & BUDL open

- Highlight PDL and type 2 letter data logger site code and AQM, (e.g.) "GR AQM" (located on front of data logger, may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password: (██████████, not case sensitive), this brings up Home Menu
- Select: "C" configuration menu
- Select: "S" configure System Parameters
- Highlight Logger Time <ENTER>
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**
- Highlight BUDL and type the 2 letter data logger site code and AQM (e.g.) "UG AQM", (located on front of data logger, may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password: (██████████, not case sensitive), this brings up Home Menu
- Select: "C" configuration menu
- Select: "S" configure System Parameters
- Highlight Logger Time <ENTER>
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**

B) Filter Change Procedure

The Teflon filter needs to be replaced before doing a calibration. After the initial calibration, only change the filter after completing the Calibration Check. The filter used is a 5.0-micron Teflon filter. If there are leaks, correct the problem before doing the calibration. If there are no leaks, proceed to document the remaining operational checks in this section and then call the ECB before conducting a calibration. Record in logbook.

1. Remove the screws in the filter holder and disassemble.
2. Remove the existing filter.
3. Touching only the outer edges, place the new filter in the holder.
4. Reassemble the filter holder and carefully tighten the screws. **Do not over tighten the filter holder for this can tear the filter and/or damage the holder.**
5. Run a Leak Check to test the integrity of the filter. Record in logbook.

C) Model 48S Leak Check

The Leak Check must be performed before a Calibration.

Equipment Required:
Teflon caps - 1/4"

a) **Sample Route thru Solenoid:** In order to test for the presence of external leaks around the fittings, plug the **Sample** inlet fitting with a cap. Press the Test P/T button once. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. The flow on the Model 48S rotameter should gradually decrease to zero if no leak is present. The pressure on the LED (Light Emitting Diode) display should drop to below 250 mmHg. If the pump diaphragm is in good condition and the capillary is not blocked, it should take less than one minute from the time the inlet is plugged to the time the reading below 250 mmHg is obtained. If this takes longer than one minute, check the integrity of the pump diaphragm and check for blocking of the capillary. If no leak is found, remove cap on solenoid.

b) **Cal/Span Gas Route thru Solenoid:** Press the Test P/T button once. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. Plug the **Calibration** gas inlet fitting on the solenoid with a cap. The flow on the Model 48S rotameter should gradually decrease to zero if no leak is present. The pressure on the LED (Light Emitting Diode) display should drop to below 250 mmHg. If the pump diaphragm is in good condition and the capillary is not blocked, it should take less than one minute from the time the inlet is plugged to the time the reading below 250 mmHg is obtained. If this takes longer than one minute, check the integrity of the pump diaphragm and check for blocking of the capillary. If no leak is found, remove cap on solenoid.

D) Zero (Ø) Calibration

Disable Channels on Data Loggers if channels are up. While disabled, values are collected but flagged as invalid data.

a. Disable channels

- {ESC} to Home Menu on PDL
- Select: "C" Configuration Menu
- Select: "D" Configure Data Channels
- Select: "M" "Disable/Mark Channel Offline"
- Use arrow key to select pollutant, <ENTER>
- Highlight COUA then press, <ENTER>
- Highlight COA then press, <ENTER>
- From Home Menu repeat steps on BUDL
- Record time that channels are disabled

b. Change COZAdj Cal time (to prevent COZAdj events from triggering during calib)

- {ESC} to Home Menu on PDL & select "C" Configuration Menu
- Select: "C" Configure Calibration
- Select: "C" Change Old Cal Program
- Select: "COZAdj", <ENTER>
- Highlight starting time and change to xx (odd):46
- Arrow down to "Finished Conf Now", <ENTER>

- {ESC}{ESC} to home menu
- c. Check and Record K_1 Math Constant
 - Select PDL & select "C" Configuration Menu
 - Select: "K" Configure Math Constants
 - From home menu in BUDL repeat process
 - Record K_1 PDL & BUDL values in e-logbook
- d. Run Calibration \emptyset , **0 ppb Carbon monoxide**
- The 8816 datalogger will be set up to run a Span \emptyset . During this time, the span levels required for the Calibration will be controlled via the 146C Calibrator.
 - {ESC} {ESC} {ESC} to Home Menu
 - Select PDL & select "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "1" Start a Single Phase Calibration
 - Select: **COZADJ** <ENTER>
 - Select: **SPAN \emptyset** <ENTER>
 - Check to see if "Phase Duration" is "26m"
 - Select "Start Single Cal (NOW) " <ENTER>
 - {ESC} {ESC} to Home Menu of PDL
 - Select "D" Real Time Display
 - Select "B" Display Last Base Average: shows the last 1 min average only w/ flag D:Disabled & C:Calibration for COUA & COA, <ENTER>
 - Select BUDL and start Display Last Base Average
 - Once readings stabilize, adjust using Zero "Course, Medium, and Fine" thumbwheel on the 48S until a zero COA of 20-75 ppb is obtained.
 - The BUDL mirrors the activity of the PDL. The instrument control is via the PDL. The BUDL screen is used to view the Real Time data either as Last Base Avg.
 - Record 5 x 1-minute average carbon monoxide for COUA & COA Span \emptyset concentrations from the PDL, BUDL, and TEI 146C in the electronic logbook in the Calibration Table.
 - Average the five (5) 146C Display, PDL, and BUDL values for each event. Compare the 146C "True Carbon monoxide" to the corresponding PDL and BUDL values.
 - Select "W" abort Zero COAdj, enter new K_1 factor into PDL and BUDL (must be entered after selecting "W" abort zero).

Calibration	146C	PDL / BUDL	
		COUA	COA
Zero	0 ppb	0 - 150 ppb	20 -75ppb

E) Multi-Point Procedure

a. Run Calibration Span1, 4000-5000 ppb Carbon monoxide

- Select PDL & select "C" Configuration Menu
- Select: "C" Calibration Configuration
- Select: "1" Start a Single Phase Calibration
- Select: "COCAL" <ENTER>
- Select: "SPAN1" <ENTER>
- Under "Phase Duration" enter "1h"
- Select: "Start Single Cal (NOW)" <ENTER>
- {ESC} to Home Menu of PDL
- Select "D" Real Time Display
- Select "B" Display Last Base Average: shows the last 1 min average only w/ flag D:Disabled & C:Calibration for COUA & COA, <ENTER>
- Select BUDL and select "B" Display Last Base Average
- Once readings stabilize, adjust COA using the "Course, Medium, and Fine" thumbwheel on the 48S, (Adjust Span 1 only)
- Record 5 x 1-minute average carbon monoxide Span 1 concentrations from the PDL, BUDL, and TEI 146C in the electronic logbook in the Calibration Check Table.
- Average the five (5) 146C Display, PDL, and BUDL values for each event. Compare the 146C "True Carbon monoxide" to the corresponding PDL and BUDL COA values.

Review Each Calibration Point results from the data logger.

Calibration	146C	PDL / BUDL	
		COUA	COA
Span 1	4000 -5000 ppb	0 - 235 ppb	± 160 ppb
Span 2	2000 - 2500 ppb	0 - 155 ppb	± 80 ppb
Span 3	250 - 500 ppb	0 - 87 ppb	± 12 ppb

All COA points must be within 4% of the actual concentration. If the new calibration curve does not meet the above criteria repeat steps including the checks. If second attempt to calibrate fails, contact ECB.

- Abort the Span 1 after 5 minute averages have been recorded.
 - {ESC} to Home Menu of PDL
 - Select PDL & select "C" Configuration Menu
 - Select "C" Configure Calibration
 - Select "W" Abort Calibration
 - Select "COCAL " <ENTER>
 - Repeat above steps (starting with E.a) for "SPAN2" & "SPAN3"

If the criteria are met proceed below.

The Data logger Channels must be "Upped" (brought back online) to collect ambient air carbon monoxide concentration data.

- b. Abort Calibration on PDL
 - Procedure:
 - {ESC} to Home Menu on PDL
 - Select: "C" Configuration Menu
 - Select: "C" Configure Calibrations
 - Select: "W" Abort a Calibration Program
 - Select: **COCAL** press <ENTER>, this stops the calibration

- c. Change COZAdj Cal time
 - {ESC} {ESC} to Home Menu on PDL & select "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "C" Change Old Cal Program
 - Select: "COZAdj"
 - Highlight starting time and change to next odd hour "xx:46:00"
 - With down arrow key highlight "**Configure Now**" then press, <ENTER>

- d. Enable channels
 - {ESC} to Home Menu on PDL
 - Select: "C" Configuration Menu
 - Select: "D" Configure Data Channels
 - Select: "E" "Enable/Mark Channel Online"
 - Use arrow key to select pollutant, <ENTER>
 - Highlight COUA then press, <ENTER>
 - Highlight COA then press, <ENTER>
 - Repeat steps on BUDL
 - Record time that channels are enabled

Turn off Computer screen. **Note: DO NOT** close the ESC Digitrend Operating Software, **DO NOT** turn off the computer.

2.16.2.3 CALIBRATION CHECK

A) Operational Checks

1) Site Checks

Upon arrival at the site, observe the outside of the sampling building and probe, looking for vandalism or security breaches. If there is any evidence of vandalism contact the appropriate law enforcement department (generally this is the city police department if the monitor is within city limits, and the county sheriff's department if outside city limits)

and headquarters. Record your observations in the logbooks and **do not make any adjustments to the front panel controls during these checks.** Except for particulate filter changes, phone ECB (Electronics and Calibration Unit) for guidance before making any adjustments to the front panel controls.

Inspect the Inverted Funnel, Wire Screen, Sample Probe Line, and Calibration

Line: visually inspect and document the condition of the sample delivery and calibration tubing systems. This inspection should also be performed during each site visit. The probe should be turned down, an undamaged inverted funnel on the end, the wire screen must be in place to protect the sampling probe from insects and foreign material, and the Teflon line must be visible inside the funnel screen.

Power On and Sample Line Check: observe the analyzer, calibrator, computer, and data loggers for indications of power failure, and if needed, correct the cause. Verify the instrument "POWER" light is lit and there is an audible sound from the external pump. If the analyzer or calibrator lost power, allow an equilibration period of at least an hour for the instrument(s) to stabilize. Visually inspect the tubing, especially at any bends, to ensure that it has not been accidentally kinked, crimped, cut, or insects are nested in the lines. Particulate matter may also load the sample line ahead of the inlet filter. Such restrictions can usually be determined by disconnecting the inlet line of the sample pump. If pump performance is significantly improved and the inlet filter itself is not loaded with particulate matter, the sample line may require replacement. Record all events in logbook. Notify supervisor and call the ECB for instructions on length of stabilization period and recycling the data logger if necessary.

Check on Gas Cylinder and 146C Calibrator: verify the gas cylinder and calibrator are in certification (calibrator certification sticker on front panel) and document certification dates in logbook. (If the cylinder pressure is **less than 500 psig** arrange with ECB when the Region will do a calibration check before delivery of the cylinder. Calibrate after the new cylinder is installed per **2.16.2.2**. Verify that the 146C has the correct cylinder concentration stored in memory.

Range Check: verify that the range is at the correct setting of **5 ppm** for CO by engagement of the STAT pushbutton #2 option. If the range has been changed, determine when and by whom. Invalidate all data in the wrong range. Notify supervisor and Quality Assurance Coordinator immediately, conduct a calibration check (2.16.2.3E), re-enter the range to the correct entry, then recalibrate (2.16.2.2B).

Time Switch Settings – Press STAT three times for **time**. Verify that the **time switch** is set to **22**.

Station Temperature Check: measure and record the site temperature in °C. Adjust the site thermostats as necessary to maintain the 20° to 30°C range. If the temperature is

outside of the 20° to 30°C range, notify the Regional Chemist and the ECB to correct the problem and invalidate data if necessary.

Detector Frequency Check: check the infrared light intensity in Hz by pressing the INT button once, record the reading, press again, and record the reading. Both readings should be at least 10,000 Hz. If not, call the ECB. (**Note: If greater than 30,000 Hz, call ECB**)

Pressure/Temperature Check: check the pressure transducer by pressing the P/T button once and record the reading. The display should agree with the ambient pressure by **±10 mm Hg**. If not, check the particulate filter for dirt loading and replace as necessary. Replace and tighten cover, again ensuring that the O-ring seal is aligned. If the value still disagrees with the ambient pressure, call the ECB. Check the temperature transducer in degrees C by pressing the P/T button again. The display should read between **31°** and **40°C**. If the readings are not in this range, call the ECB.

Model 111 Zero Air Pak and Compressor Checks: the silica gel in the cartridges located on the back of the Zero Air Pack removes the moisture from the compressed air before the carbon monoxide is removed from the dried air by the internal carulite canister. Silica gel, though, has a limited capacity to effectively remove moisture from the air stream. Because of this limited capacity, the silica gel must be replaced every 14 days or less to insure effective moisture removal in both cartridges. Verify that the silica gel is not spent by color change. When the gel is new it is a dark blue in color. If the gel is spent, it is a lighter blue in color with white crystals. If the gel is spent or it has been 14 days since it was last changed, replace it, and return it to the ECB for regeneration. Check the condition of the Purifill. Fresh Purifill is purple and turns brown when saturated. Replace when purple color is less than 20% of the volume. Remove the cartridge holding the Purifill, unscrew the cap, discard used Purifill, replace with fresh and screw on the cap and replace cartridge. Record in logbook. On an annual basis, change all scrubbing medium.

Verify and record that the outlet pressure on the air compressor is reading between 40 and 50 psi. Verify and record that the ZAP is reading between 20 and 40 psi. If either pressure reading is outside of these ranges, contact the ECB and record corrective action. Also, check and drain any water from the compressor (do this at every site visit).

2) **TEI 48S Analyzer and 146C Calibrator Alarm and Operational Checks**

Basic checks of the instrumentation.

Alarm Check (146C Calibrator)

Check the TEI 146C Run Screen

- 1) Make sure the 146C is in "**Remote**" mode (press <MENU> button on the front of the instrument). The 146C has to be in the "**Remote**" mode in order to activate the internal span solenoid inside the 48S.

Check for "**Alarm**" on the displays. If no alarms are present, record the "Alarm On" checks in the logbook as "**no**" and continue. If either screen shows an alarm, record the "Alarm On" check as "**yes**" in the logbook for the appropriate instrument/s. View the Alarm menu to determine the cause.

- 2) Use the ↑ or ↓ menu pushbuttons to select the **Alarm Submenu**, <ENTER>
- 3) Use the ↑ or ↓ menu pushbuttons to select the item that is in Alarm Status.
NOTE: Items that are not in alarm status are labeled "OK", <ENTER>
- 4) Determine the cause of the alarm. Consult with the ECB prior to performing calibrations or maintenance.
- 5) Press the <MENU> button twice to return to the main menu screen.

The following Alarm Limit is used in the CO operation of the TEI 146C Calibrators:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Internal Temperature	18.5°C	47°C

The following Test mode parameter ranges are allowed in the TEI 48S Analyzer:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Flow (rotameter)	0.5 LPM	2.0 LPM
Lamp Intensity (1 & 2)	10,000 Hz	30,000 Hz
Fscale (Stat)	0 ppm	5 ppm
CO Analytical Range	0 ppm	5 ppm
Sample Temperature	~ ambient	
Pressure	~760 mmHg	

Operational Checks (48S Analyzer and 146C Calibrator)

Cooling Fan Filter Check: on the back of the instruments there are cooling fans with sponge filters inside. Check to ensure the fans are running. Check to see if the filters are clean monthly. The fan housing can be popped off the back of the instrument and the filter may be removed and cleaned if necessary (either by rubbing with a cloth or between your hands to remove any dust or with compressed air). After cleaning, replace the filter and the housing. Record in the logbook.

Maintenance and Troubleshooting Documentation: any other suspected mechanical problems see Section 2.16.1 (ECB) for Preventative and Routine Maintenance or Appendix M for Troubleshooting. Document all of the above in the logbook.

3) Checking and setting computer, PDL, and BUDL time/date (every two weeks).
The times for the PDL, BUDL, and computer must be EASTERN STANDARD TIME.
NOTE!! The BUDL and PDL must have the same NIST time ± 1 minute; the computer time must be 5 minutes slower than the PDL/BUDL time.

Sources for getting the correct time:

1. Call the ECB and ask for the NIST time.
2. Call the NIST Colorado time @ **(303) 499-7111** (long distance).
3. Correct time loaded into cell phone.
4. Correct time website, <http://nist.time.gov/>.

Check the computer time and date at the lower right hand corner of the computer screen. If the time and date are not correct; click START button, control panel, date/time or right click computer time on taskbar, select " **Adjust Date/Time**, type in changes and select "OK ".

PDL & BUDL time and date:

- Double click 'Shortcut to Splitscreen'
- PDL & BUDL open
- Highlight PDL and type 2 letter data logger site code and AQM, (e.g.) "GR AQM" (located on front of data logger, may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password: ([REDACTED], not case sensitive) this brings up Home Menu
- Select: "C" configuration menu
- Select: "S" configure System Parameters
- Highlight Logger Time <ENTER>
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**
- Highlight BUDL and type the 2 letter data logger site code and AQM (e.g.) "UG AQM", (located on front of data logger, (may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password ([REDACTED], not case sensitive)
- Select: "C" configuration menu
- Select: "S" configure System Parameters
- Highlight Logger Time <ENTER>
- Type in correct time in the format of: **HH:MM:SS**
- **{ESC}{ESC}{ESC}**

B) Calibration Check Procedure

The purpose of the calibration check is to correlate the output of a monitoring system with known, traceable concentrations. A calibration check is required each two weeks (EVERY 14 DAYS OR LESS), but may be conducted more frequently. Conduct the calibration check(s) making **NO ADJUSTMENTS** to the monitor or data system(s).

40 CFR 58 Appendix A requires at least one precision check (250 - 500 ppb for the 5000 ppb analyzer) performed every two weeks (14 days).

Note: Do not perform checks or calibrations between 6am and 9am (Local Standard Time). This is an important data collection period.

Calibration checks must be performed prior to any component change, alignments, or calibration, if the monitor is operable. If the newly calculated calibration check is within the criteria established and if no components are changed, the new calibration check equation may be used to reduce data and the calibration is not necessary. Conduct the calibration check as follows:

- a. Log in to data logger:
 - Double click "Shortcut to Splitscreen"
 - Select PDL and hit {ESC} then type Site ID Code (e.g.) "GR AQM", <ENTER>
 - Select: "L" to login
 - Enter ([REDACTED] , not case sensitive) as the password.
 - Select BUDL and hit {ESC} then type Site ID Code (e.g.) "UG AQM", <ENTER>
 - Select: "L" to login
 - Enter ([REDACTED]) as the password

b. Calibration Check

Disable Channels on Data Loggers if channels are up. While disabled, values are collected but flagged as invalid data.

- Disable Channels on PDL and BUDL Data Logger
 - {ESC} to Home Menu on PDL
 - Select: "C" Configuration Menu
 - Select: "D" Configure Data Channels
 - Select: "M" Disable/Mark Channel Offline
 - Highlight COUA then press, <ENTER>
 - Highlight COA then press, <ENTER>
 - Repeat steps on BUDL
 - Record time that channels are disabled in electronic logbook

- Change COZAdj Cal time
 - Select PDL & select "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "C" Change Old Cal Program
 - Select: **COZADJ** and press <ENTER>
 - Highlight " **Starting Time**", change starting time to minimum of 4 hours in advance odd hour :46
 - Using down arrow key select: "Configure Now" then press, <ENTER>

 - Check and record K₁ Math Constant in PDL and BUDL
 - {ESC} to Home Menu on PDL
 - Select: "C" Configuration Menu
 - Select: "K" Configure Math Constants
 - Repeat steps for BUDL
 - Record K₁ Constant in the electronic logbook for PDL and BUDL
- C) **Zero (Ø) Calibration Check Procedure**
- Run Calibration Check (Span Ø), **0 ppb**
 - {ESC} {ESC} {ESC} to Home Menu Select: PDL & select "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "1" Start a Single Phase Calibration
 - With down arrow key, Select: **COZADJ** <ENTER>
 - Select: **SPANØ** <ENTER>
 - Under "Phase Duration" enter "1h"
 - Select: Start Single Cal (NOW) <ENTER>
 - {ESC} to Home Menu of PDL
 - Select: "D" Real Time Display
 - Select "B" Display Last Base Average <ENTER>, shows the last 1 min average only w/ flag D:Disabled & C:Calibration for COUA & COA
 - Select BUDL and start Display Last Base Average
 - The BUDL mirrors the activity of the PDL. The instrument control is via the PDL. The BUDL screen is used to view the Real Time data as Last Base Avg.
 - Record 5 x 1-minute average carbon monoxide ZERO Event concentrations from the PDL (COUA & COA), BUDL (COUA & COA), and TEI 146C in the electronic logbook in the Calibration Check Table.
 - Average the five (5) 146C Display, PDL, and BUDL values for each event. Compare the 146C "True Carbon monoxide" to the corresponding PDL and BUDL values as follows:

Cal Check	146C	PDL / BUDL	
		COUA	COA
Zero	0 ppb	0 - 220 ppb	± 20 ppb

- Abort the Zero Span after 5 minute averages have been recorded.
 - {ESC} to Home Menu of PDL
 - Select: "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "W" Abort Calibration
 - With down arrow key, select: "COZADJ" <ENTER>

D) Span Calibration Check Procedure

- Run Span1, Span 2, & Span 3
 - {ESC} to Home Menu of PDL, select "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "1" Start a Single Phase Calibration
 - Select: "COCAL" <ENTER>
 - Select: "SPAN1" <ENTER>
 - Under "Phase Duration" enter "1h"
 - Select "Start Single Cal (NOW)" <ENTER>
 - {ESC} to Home Menu of PDL
 - Select: "D" Real Time Display
 - Select: "B" Display Last Base Average <ENTER>, shows the last 1 min average only w/ flag D:Disabled & C:Calibration
 - Record 5 x 1-minute average carbon monoxide Span 1 Event concentrations from the PDL (COUA & COA), BUDL (COUA & COA), and TEI 146C in the electronic logbook in the Calibration Check Table.
 - Average the five (5) 146C Display, PDL, and BUDL values for each event. Compare the 146C "True Carbon monoxide" to the corresponding PDL and BUDL values

- Abort the Span 1 after 5 minute averages have been recorded.
 - Escape {ESC} to Home Menu of PDL
 - Select PDL & select "C" Configuration Menu
 - Select: "C" Configure Calibration
 - Select: "W" Abort Calibration
 - Select: "COCAL" <ENTER>, this stops the calibration
- Repeat above steps for "SPAN2" & "SPAN3"

Review Each COUA & COA Calibration Point results from the data logger.

Cal Check	146C	PDL / BUDL	
		COUA	COA
Span 1	4000 -5000 ppb	0 - 520 ppb	± 320 ppb
Span 2	2000 - 2500 ppb	0 - 360 ppb	± 160 ppb
Span 3	250 - 500 ppb	0 - 224 ppb	± 24 ppb

E) Filter Change Procedure

During normal operation throughout the season the Teflon filter needs to be replaced at a minimum of once per month with biweekly/14-day changes being recommended. Only change the filter after completing the Calibration Check. The filter used is a 5.0-micron Teflon filter.

1. Remove the screws in the filter holder and disassemble.
2. Remove the existing filter.
3. Touching only the outer edges, place the new filter in the holder.
4. Reassemble the filter holder and carefully tighten the screws. **Do not over tighten the filter holder for this can tear the filter and/or damage the holder.**
5. Run a Leak Check to test the integrity of the filter. Record in logbook.

F) Model 48S Leak Check

The Leak Check must be performed after a Calibration Check.

Equipment Required:

Teflon caps - 1/4"

a) **Sample Route thru Solenoid:** In order to test for the presence of external leaks around the fittings, plug the **Sample** inlet fitting with a cap. Press the Test P/T button once. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. The flow on the Model 48S rotameter should gradually decrease to zero if no leak is present. The pressure on the LED (Light Emitting Diode) display should drop to below 250 mmHg. If the pump diaphragm is in good condition and the capillary is not blocked, it should take less than one minute from the time the inlet is plugged to the time the reading below 250 mmHg is obtained. If this takes longer than one minute, check the integrity of the pump diaphragm and check for blocking of the capillary. If no leak is found, remove cap on solenoid.

b) **Cal/Span Gas Route thru Solenoid:** Press the Test P/T button once. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. Plug the **Calibration** gas inlet fitting on the solenoid with a cap. The flow on the Model 48S rotameter should gradually decrease to zero if no leak is present. The pressure on the LED (Light Emitting Diode) display should drop to below 250 mmHg. If the pump diaphragm is in good condition and the capillary is not blocked, it should take less than one minute from the time the inlet is plugged to the time the reading below 250 mmHg is obtained. If this takes longer than one minute, check the integrity of the pump diaphragm and check for blocking of the capillary. If no leak is found, remove cap on solenoid.

2.16.2.4 Review Calibration and End

Cal Check	146C	PDL / BUDL	
		COUA	COA
Zero	0 ppb	0 - 220 ppb	± 20 ppb
Span 1	4000 -5000 ppb	0 - 520 ppb	± 320 ppb
Span 2	2000 - 2500 ppb	0 - 360 ppb	± 160 ppb
Span 3	250 - 500 ppb	0 - 224 ppb	± 24 ppb

All calibration points must be within 8% of the actual concentration. If the data for the Calibration (Zero) Check, Calibration (SPAN 1) check, Calibration (SPAN 2) check, and Calibration (SPAN 3) check is not within the specified limits above; the **Calibration Check is NOT ACCEPTABLE.**

Note: When final calibration check fails on final shutdown, **do not** do a calibration. Document possible reasons; investigate if possible.

1. If the Calibration Check is NOT ACCEPTABLE:

A **CALIBRATION** of the Carbon Monoxide Monitor must be performed if the criteria above are not met.

The **CALIBRATION** Sections required to be performed after failing the Calibration Check are:

Section 2.16.2.2,B	Install a New Teflon Particulate Filter
Section 2.16.2.2,C	Perform a Leak Test
Section 2.16.2.2,D & E	Calibration Procedure

2. If the Calibration Check is ACCEPTABLE (meets criteria above) proceed.

The Data Logger Channels must be "Upped" (brought back on line) to collect ambient air carbon monoxide concentration data.

3. Change COADJ Cal Time

- {ESC} {ESC} to Home Menu on PDL
- Select: "C" Configuration Menu
- Select: "C" Configure Calibration
- Select: "C" Change Old Cal Program
- Select: "COAdj", <ENTER>
- Highlight starting time and change to next odd hour "xx:46:00
- With down arrow key, highlight "Configure Now" <ENTER>

4. Up the PDL and BUDL channels: Go to the Home Menu (by pressing {ESC} several times if needed), Press "L" and enter the code when it asks for the password and press enter).

Enable channels:

- {ESC} to Home Menu on PDL
- Select: "C" Configuration Menu
- Select: "D" Configure Data Channels
- Select: "E" "Enable/Mark Channel Online"
- Use arrow key to select pollutant, <ENTER>
- Highlight COUA then press, <ENTER>
- Highlight COA then press, <ENTER>
- Repeat steps on BUDL
- Record time that channels are enabled

Note: In the split screen operation, the data loggers can be accessed by pressing CTRL and {ESC} to access the TASK list, you can enter onto either of the two data loggers by highlighting the data logger and pressing <ENTER>.

Turn off Computer screen. **Note: DO NOT** close the ESC Digitrend Operating Software, **DO NOT** turn off the computer.

2.16.2.5 Site Calls

(See *Section III: Regional Office Responsibilities: EDAS set-up; Retrieval, Review, Correction and Storage of Data; Report Submission*, for site operator's duties between visits.)

To minimize travel some site operational checks must be made by telephone. Site calls are recommended every working day. Calls to a site can be made at any time; however an effort to avoid calling during the first 5 minutes of an hour should be made in order to avoid conflict with the calls made by the automated polling process of the DMSSB (Data Management and Statistical Services Branch) headquarters computer. At a minimum request yesterday's data and today's data. If calling on a Monday, retrieve the data for Friday, Saturday, and Sunday as well.

Note: Make sure the modem speed (BAUD rate) is set correctly for the corresponding site (i.e. if set to 300 BAUD it will not work usually on a 2400 BAUD). If you are uncertain as to what speed modem your site is operating, call the ECB or DMSSB for assistance. Often times a site operator can call a site if it is set to the incorrect BAUD rate, and the site will NOT respond. This is a common problem and can easily be avoided by making sure the rate(s) correspond.

Review the Reports For Flagged Data.

Flags are assigned to data to indicate its validity. If no flag follows a value, the data is assumed accurate and valid. These data are used in all appropriate averages. Compare any flagged data with what is expected to occur such as nightly auto-calibrations. If any of the flagged data appears unusual make a note to check the back up data collected during the next site visit. If several values are invalid, a site visit may be needed. If a channel is incorrectly marked "D" (down) the data may be valid and you will need to notify headquarters of any valid data to be reported.

Compare the monitor zero results to the zero for each day. Compare the monitor span results to the known calibrator output for each day. Review the power failure report. Review the log for temperature inside the building. See the section (III) on "polling" for complete flag and review procedures.

2.16.2.6 Data Reporting and Validation for Regional Offices (See *Section IV: Continuous Monitor QA Plan Section, Headquarters Responsibilities.*)

Data Validation for Regional Offices: The regional office is responsible for data validity.

Verify that all periods of missing or invalid data have been accounted for, and the reasons have been identified for missing or invalid data on the Monthly File Listing or on an AQ-42 in remarks.

The operator must review all AQ-42s for unusually high or low concentrations.

The operator signs, dates, and submits the completed AQ-42s to the DMSSB in Ambient Monitoring in Raleigh

Each month, the DMSSB initiates a data review by printing a raw data report for each field office. Each month, the Regional Offices will be requested to send selective sets of BUDL data that are needed beyond what is already needed by DMSSB for verifying the missing value imputations supplied by the field office. DMSSB requested Backup Data Logger files should be FTP'ed to the DMSSB within 5 working days.

All monthly data should be submitted to headquarters within 10 working days from the end of the collection month.

All data, including logbooks and supporting printouts must be kept for five years.

2.16.2.7 Quality Assurance Procedures

The Quality Assurance Program requires strict adherence to approved procedures including the performance of specific tasks and activities. The determination of adherence to the approved procedures and the quality of ambient air data collected at each site includes the biweekly precision point analysis performed by the site operators, the monitor accuracy audits performed independently by the ECB, and a complete systems audit performed by the staff of the Ambient Monitoring Section of the Division of Air Quality of each monitoring site and the ECB. This approach provides the essential ongoing and independent evaluation of data quality and reliability for the entire ambient air quality data set collected at each site and statewide. **Strict adherence to the established approved procedures is required to enable the Division of Air Quality to certify that the data collected is true and representative of the ambient levels of carbon monoxide in the State of North Carolina.** Certain information must be available to the auditor. Even though this information can be provided through access to the instrument logbook, use a Continuous Monitor Quality Assurance Report form (AQ121 / CMQAR) to give a better overview of each audit. (See Appendix B for the CMQAR example.)

Site Operator Responsibilities

The critical part of the site operator's role in the Quality Assurance Program is the adherence to approved operating procedures, performing the required precision point analysis, and maintaining accurate records of all monitoring site activities. It is the site operator's responsibility to notify the Regional Air Quality Chemist of the performance of each carbon monoxide monitoring system during and/or immediately following each monitoring site visit. The site operators and the Regional Air Quality Chemist are jointly responsible for timely data validation and reporting.

Precision Point Analysis. Every two weeks (**EVERY 14 DAYS OR LESS**), the precision point analysis must be performed on each CO analyzer as part of the Calibration Check procedures. The results of this precision point analysis are required to be reported to the DMSSB at the end of each quarter. Data validation must be conducted by the operator on a routine basis according to section IV of this QA plan.

The Regional Air Quality Chemist should verify that all site visits and precision analysis are conducted as required.

Accuracy Auditing.

The ECB performs all CO monitoring sites accuracy audits. The operator shall assist if requested by ECB auditor in conducting accuracy audits.

Interagency Auditing.

Interagency audits may take place between the DAQ and Local Programs. Also, U.S.E.P.A. Region IV may schedule audits for various parameters, including CO, throughout the year.

Audit Evaluation and Corrective Action.

For the precision audit and the accuracy audit, corrective action should be initiated by the Project and Procedures Branch supervisor, and documented at the bottom of the AQ121 Audit Form. An investigation must be undertaken to determine the cause of unusually poor audit results when any result exceeds a $\pm 15\%$ difference. Documentation of the correction will be provided to the Section Chief, with the QA report.

Data Verification.

The Regional Air Quality Chemist is responsible for all data verification activities.

Systems Auditing.

The Regional Ambient Air Monitoring Staff shall participate and assist in the Annual Systems Audit performed by the Ambient Monitoring Section. All records and documentation must be available for review.

2.16.2.8 Monitor Shutdown Procedure

1. Down the associated parameter.
2. Disable the associated calibrations on the PDL by selecting Configure Calibrations then Change Old Cal Program. From the list choose "**COCAL**" for CO. Change the dates of the next auto cal on the Starting Time to a future date.
3. Turn the CO monitors power off. Pull the power plugs out for protection from lightning.
4. Shut off the cylinder valve and the outlet valve on the regulator.
5. Contact ECB, PPB and DMSSB Supervisor to acknowledge site shutdown.