

Carbon Monoxide QA Plan  
Section II

Operators Responsibilities

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## 2.9.2 CO Monitoring Site Operation Procedures

### 2.9.2.1 Procedures for Site Operation and Calibration for Carbon Monoxide (CO) Monitor Sites

The Division of Air Quality of the Department of Environment and Natural Resources determines the ground level concentration of ambient air carbon monoxide throughout North Carolina as required by the 1970 Clean Air Act and the subsequent Amendments (1977 & 1990) 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. Carbon monoxide is 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.

The State of North Carolina operates two types of Carbon Monoxide (CO) monitors across the state. Section 2.9.0 is for monitoring to meet the National Ambient Air Quality Standards (NAAQS). The state also operates High Sensitivity CO monitors with a much lower overall range. Those procedures are located Section 2.16.0. In order to collect accurate, meaningful data the monitors must be operated in a consistent manner. Carbon monoxide monitoring is conducted at sites from October to March. 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 applies to the CO 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 or less – PRECISION CHECK
  - Includes before any maintenance procedures.
  - 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.
- 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).

#### **B. Monitoring Instrumentation, Equipment, and Accessories:**

- TEI/TECO Model 48C CO Analyzer
- TEI 146C Dynamic Gas Calibrator
- Model 1001 Zero Air Supply System
- Nighthawk Carbon Monoxide Alarm User's Guide
- ESC 8816 Data Loggers: primary datalogger (PDL) & backup datalogger (BUDL)
- Uninterruptible power supply (UPS) is recommended if you autopoll your monitors at scheduled times
- Dedicated site PC
- Telephone modem

#### **C. Safety Issues and Concerns**

- A gas cylinder of 760-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.**
- General safety precautions related to the use and transport of pressurized gas cylinders.

### 2.9.2.2 CALIBRATION

#### A) **Operational Checks for CO 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. Except for particulate filter changes, phone ECB (Electronics and Calibration Branch) 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** notify ECB so they can arrange for a new cylinder). Verify that the 146C has the correct cylinder concentration stored in memory.

#### 146C Calibrator

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

**Station Temperature Check:** measure and record the site temperature in °C. 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. Check the data logger through hyper terminal.

**Range Check:** (**Note:** normal operation for the 48C is **REMOTE**) verify that the range is at the correct setting of 50 ppm for CO by engagement of the MAIN MENU pushbutton, RANGE 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 (48C changes are made only in the **local** mode), then recalibrate. Verify the AVERAGING TIME by engagement of the MAIN MENU pushbutton, AVERAGING TIME option is set to 60 seconds.

**Detector / Frequency Check:** check the infrared light intensity in Hz from the MAIN MENU pushbutton, DIAGNOSTICS, "AGC INT" button, record the reading. Reading should be at least **150,000 Hz** (**Note!! If greater than 300,000 Hz call the ECB**).

Record the values in the logbook. If outside the limits complete the calibration and perform all of the monitor checks with adjustments and then continue with the calibration with corrections.

**Temperature/Pressure Check:** check the temperature by selecting the **Temperature (Internal and Chamber)** and **Pressure** from the MAIN MENU, DIAGNOSTICS, and record the reading. The display for the **Internal** temperature should read between **8°** and **47°C** and the **Chamber** temperature should read between **40°** and **52°C**. The display pressure should agree with the ambient pressure by **±20 mm Hg** (compare against site certified pressure gauge). If not, check the particulate filter for dirt loading, replace and tighten holder. If the readings are not in this range, call the ECB.

**Model 1001 Zero Air Pak:** the silica gel in the cartridges located on the back of the Zero Air Pak removes the moisture from the compressed air before the hydrocarbons are removed from the dried air by the internal activated charcoal filter. 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. Record in logbook.

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

**Alarm Checks 146C Calibrator**

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 as described in "1) Site Checks" to determine the cause:

- a. Check the TEI 146C Run Screen. If the word "Remote" is not displayed, press <MENU> <ENTER> until "Remote" is displayed (The 146C has to be in the REMOTE MODE in order to activate the internal span solenoid inside the 48C).

Press "MENU" on the 146C front panel to get to the MAIN MENU.

Use the ↓ pushbuttons to select "Alarms" <ENTER>

Use the ↑ or ↓ pushbuttons to select "Internal Temps" <ENTER>

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	20°C	50°C

**Alarm Checks 48C Analyzer**

- a. Check the TEI 48C Run Screen. Use the MAIN MENU pushbutton to select the Alarm Submenu, <ENTER>
- b. Use the ↑ or ↓ pushbuttons to select the item that is in Alarm Status.  
**NOTE: Items that are not in alarm status are labeled "OK",**
- c. Determine the cause of the alarm(s). Consult with the ECB prior to performing calibrations or maintenance.

The alarm limits allowed in the TEI 48C Analyzer MAIN MENU, diagnostics:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Supply Voltages	± 0.5v	
Alarm Bias	-100v	-130v
Battery	2.0v	3.5v
Internal Temperature	8° C	47° C
Chamber Temperature	40° C	52° C
Pressure	250-mmHg	1000-mmHg
Flow	.350 LPM	1.50 LPM

Sample/Reference Ratio	1.14	1.18 (when zero air is being sampled)
Automatic Gain Control (AGC) Int	150,000 Hz	300,000 Hz
Motor Speed	100%	

d. Press the <RUN> button to return to the main menu screen.

### **Operational Checks (48C Analyzer and 146C Calibrator)**

**Cooling Fan Filter Check:** on the back of the instruments there are cooling fans with sponge filters outside. Check to ensure the fans are running. Check to see if the filters are clean. The fan housing can be popped off the back of the instrument and the filter may be removed and cleaned if necessary (with compressed air). After cleaning, replace the filter and the housing. Record in the logbook. Call the ECB if the filter material needs replacing.

### **3) Checking and 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 time  $\pm 1$  minute; the computer time must be 5 minutes slower than the PDL/BUDL time.**

Sources for getting the correct time:

1. Call the ECB
2. Call the NIST Colorado time @ **(303) 499-7111**
3. Correct time from 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 ".

- Double click 'Shortcut to Splitscreen'
- PDL & BUDL open
- Highlight PDL and type 2 letter data logger site code (located on front of data logger) and AQM (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 (located on front of data logger) and AQM (may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password: "██████" (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}

Check time and date on 48C to agree with computer time  $\pm$  1 minute (**Note:** 48C must be in "**Local mode**" to make changes).

#### 48C MAIN MENU

- Using the ↓ pushbutton, select INSTRUMENT CONTROLS <ENTER>
- Using the ↓ pushbutton, select TIME <ENTER>
- Using the ↑, ↓, ←, and → pushbuttons, move cursor to change number(s), <ENTER>

#### Calibration Factors

##### 48C MAIN MENU

- Using the ↓ pushbutton, select Calibration Factors <ENTER>
- Record **As Found** numbers in e-log for:  
BKG (background), SPAN GAS and CO COEF
- Repeat for **After Calibration** numbers in e-log for:  
BKG (background), SPAN GAS and CO COEF

#### 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.

1. Separate 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. **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 48C Leak Check

The Leak Check must be performed before a Calibration.

Equipment Required:

Teflon/stainless steel caps - 1/4"

a) **Sample Route thru Solenoid:** In order to test for the presence of external leaks around the fittings, plug the "**Probe**" inlet fitting with a cap. From the 48C **MAIN MENU** select **Diagnostics, Pressure** to check pressure. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. The flow on the Model 48C 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 probe inlet fitting.

b) **Cal/Span Gas Route thru Solenoid:** Activate solenoid by logging in using the datalogger and activating a zero. From the 48C **MAIN MENU** select **Diagnostics, Pressure** to check pressure. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. Plug the "**Span**" gas inlet fitting with a cap. The flow on the Model 48C 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 span inlet fitting.

**D) Zero (Ø) Calibration**

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

- Procedure:
  - Highlight PDL & scroll using arrow keys, select "**C**" Configuration Menu
  - Select: "**D**" Configure Data Channels
  - Select: "**M**" Disable/Mark Channel Offline
  - Select: "**CO**"
  - {**ESC**} {**ESC**} to Home Menu
  - 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 CO, <ENTER>
  - Highlight BUDL and follow the same steps to disable the channel
  - {**ESC**} {**ESC**} to Home Menu on both PDL & BUDL

a. **Run Calibration Ø, 0 ppm Carbon monoxide**

- The 8816 datalogger will be set up to run a Span Ø.

- Procedure: (To setup Span Zero through 8816 PDL)
  - Highlight PDL & Select "C" Configuration Menu
  - Select: "C" Configure Calibration
  - Select: "1" Start a Single Phase Calibration
  - Select: "COCAL" <ENTER>
  - Select: "ZERO" <ENTER>
  - Check to see if "Phase Duration" is "1h", hit down arrow, type in 60 min <ENTER>
  - Select: "Start Single Cal (NOW)" <ENTER>
  - {ESC} {ESC} to Home Menu
  - Select: "D" Real Time Display
  - Select: "B" Display Last Base Avg: shows the last 1 min average only w/flag "D": Disabled & "C": Calibration, <ENTER>
  - After instrument has stabilized, read five (5) consecutive averages, put 48C in **Local** mode, <ENTER> to get to local, screen should read "**Span Time Local**".  
(Note: "Span" should be visible when doing any point)
  - From 48C select: **Main Menu, Calibration**, <ENTER>, **Calibrate Zero** <ENTER>, <ENTER>, when panel stops flashing it is calibrated.
  - 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 CO Span Ø 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 as follows:

<u>146C</u>	<u>48C</u>	<u>PDL</u>	<u>BUDL</u>
0 ppm	0 ppm± 0.25	0 ppm ± 0.5	0 ppm ± 0.5

Abort the Zero Span after 5 stable minute averages have been recorded

- Procedure
    - {ESC} to Home Menu on PDL
    - Select: "C" Configuration Menu
    - Select: "C" Configure Calibrations
    - Select: "W" Abort Cal
    - Select: "COCAL" press <ENTER>: this stops the calibration
- E) **Multi-Point Procedure**
- a. Run Calibration Span 1, **42 ppm Carbon monoxide**

- The 8816 PDL continues in Span Zero while the Calibration Levels are changed. Calibration values should continue to be observed via the PDL & BUDL as well as the Calibrator and Analyzer.
- Procedure
  - From Home menu highlight PDL & Select "C" Configuration Menu
  - Select: "C" Configure Calibration
  - Select: "1" Start a Single Phase Calibration
  - Select: "COCAL" <ENTER>
  - Select: "SPAN 1" <ENTER>
  - Check to see if "Phase Duration" is "1h", hit down arrow, type in 60 min <ENTER>
  - Select: "Start Single Cal (NOW)" <ENTER>
  - {ESC} {ESC} to Home Menu
  - Select: "D" Real Time Display
  - Select: "B" Display Last Base Avg: shows the last 1 min average only w/flag "D": Disabled & "C": Calibration, <ENTER>
  - Allow system to equilibrate at 42 ppm and monitor values.
  - From the 48C MAIN MENU: select Calibration <ENTER>
  - Select Calibration "CO" <ENTER>
  - Enter the CO concentration (from the 146C MAIN MENU, press "RUN") using the ↑, ↓, ←, and → pushbuttons on the third line.
  - Press <ENTER> to calibrate the CO reading to the CO calibration gas.
  - 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 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.
  - Run the Span 2 (18 ppm) and Span 3 (9 ppm) levels.
  - Put 48C back to **Remote** after Span 3 calibration.

<u>146C</u>	<u>48C</u>	<u>PDL</u>	<u>BUDL</u>
42 ppm	42 ppm ± 0.5	42 ppm ± 0.5	42 ppm ± 0.5
18 ppm	18 ppm ± 0.5	18 ppm ± 0.5	18 ppm ± 0.5
9 ppm	9 ppm ± 0.5	9 ppm ± 0.5	9 ppm ± 0.5

**Note:** If criteria for span Ø and span 1 calibration are not met, contact ECB.

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.**

- a. Abort Calibration on PDL
  - Procedure
  - {ESC} to Home Menu on PDL
  - Select: "C" Configuration Menu
  - Select: "C" Configure Calibrations
  - Select: "W" Abort Cal
  - Select: "COCAL" press <ENTER>: this stops the calibration
  - {ESC} {ESC} to Home Menu (If access is denied, Log on again by pressing {ESC} and type the two character site code and **AQM** (with no spaces)
  
- b. Enable Channels on PDL & BUDL
  - {ESC} to Home Menu on PDL and select: "C" Configuration Menu
  - Select "D": Configure (Data) Channels
  - Select "E": Enable/Mark Channel Online
  - Select "CO" and press <ENTER>
  - When finished, exit to the "Home Menu", by pressing {ESC} and {ESC}
  - Verify the flags are cleared and the channel is enabled by pressing "D" and then "F".
  - If the flags are cleared, press {ESC} and {ESC} to go back to the home menu, press "O" to Log out and **CTRL-ESC** to exit
  - Highlight BUDL and follow the above instructions for enabling the CO Channel
  - Exit the PDL Split Screen operation
  - Repeat procedure for BUDL

Check Digtrend scheduler before site exit to ensure polling times are correct and that it is setup to collect data.

### **2.9.2.3 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 Branch) 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 notify ECB so they can arrange for a new cylinder). Verify that the 146C has the correct cylinder concentration stored in memory.

146C Calibrator

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

**Station Temperature Check:** measure and record the site temperature in °C. 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. Check the data logger through hyper terminal.

**Range Check:** (Note: normal operation for the 48C is REMOTE) verify that the range is at the correct setting of 50 ppm for CO by engagement of the MAIN MENU pushbutton, RANGE 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, (2.9.2.3B), re-enter the range to the correct entry, then recalibrate (2.9.2.2D). Verify the AVERAGING TIME is set to 60 seconds.

**Temperature/Pressure Check:** check the temperature by selecting the **Temperature (Internal and Chamber)** and **Pressure** from the MAIN MENU, DIAGNOSTICS, and record the reading. The display for the **Internal** temperature should read between **8°** and **47°C** and the **Chamber** temperature should read between **40°** and **52°C**. The display pressure should agree with the ambient pressure by **±20 mm Hg** (compare against site certified pressure gauge). If not, check the particulate filter for dirt loading, replace and tighten holder. If the readings are not in this range, call the ECB.

Record the values in the logbook but DO NOT adjust if outside the aforementioned limits. If outside the limits, complete the calibration check (2.9.2.3B), perform all of the monitor checks with adjustments, and then continue with the calibration (2.9.2.2D), with corrections.

**Model 1001 Zero Air Pak:** the silica gel in the cartridges located on the back of the Zero Air Pak removes the moisture from the compressed air before the hydrocarbons are removed from the dried air by the internal activated charcoal filter. Silica gel, though, has a limited capacity to effectively remove moisture from the air stream. Because of this limited capacity, the silica gel in both cartridges must be replaced every 14 days or less to insure effective moisture removal. 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. Record in logbook.

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

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:

### Alarm Check 146C Calibrator

a. Check the TEI 146C Run Screen. If the word "**Remote**" is not displayed, press <MENU> <ENTER> until "**Remote**" is displayed (The 146C has to be in the REMOTE MODE in order to activate the internal span solenoid inside the 48C).

Press "**MENU**" on the 146C front panel to get to the **MAIN MENU**.

Use the ↓ pushbuttons to select "Alarms" <ENTER>

Use the ↑ or ↓ pushbuttons to select "Internal Temps" <ENTER>

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	20°C	50°C

**Alarm Checks 48C Analyzer**

- a. Check the TEI 48C Run Screen. Use the **MAIN MENU** pushbutton to select the **Alarm Submenu**, <ENTER>
  - b. Use the ↑ or ↓ pushbuttons to select the item that is in Alarm Status.
- NOTE: Items that are not in alarm status are labeled "OK",**
- c. Determine the cause of the alarm(s). Consult with the ECB prior to performing calibrations or maintenance.

The alarm limits allowed in the TEI 48C Analyzer MAIN MENU, diagnostics:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Supply Voltages	± 0.5v	
Bias	-100v	-130v
Battery	2.0v	3.5v
Internal Temperature	8° C	47° C
Chamber Temperature	40° C	52° C
Pressure	250-mmHg	1000-mmHg
Flow	.350 LPM	1.50 LPM
Sample/Reference Ratio	1.14	1.18 (when zero air is being sampled)
Automatic Gain Control (AGC) Int	150,000 Hz	300,000 Hz
Motor Speed	100%	

- d. Press the <RUN> button to return to the main menu screen.

**Operational Checks (48C Analyzer and 146C Calibrator)**

**Cooling Fan Filter Check:** on the back of the instruments there are cooling fans with sponge filters outside. Check to ensure the fans are running. Check to see if the filters are clean. The fan housing can be popped off the back of the instrument and the filter may be removed and cleaned if necessary (with compressed air). After cleaning, replace the filter and the housing. Record in the logbook. Call the ECB if the filter material needs replacing.

**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 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
2. Call the NIST Colorado time @ **(303) 499-7111**
3. Correct time from 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 ".

- Double click 'Shortcut to Splitscreen'
- PDL & BUDL open
- Highlight PDL and type 2 letter data logger site code (located on front of data logger) and AQM (may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password: "██████" (not case sensitive), this brings up PDL 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 (located on front of data logger) and AQM (may have to hit {ESC} a couple of times before typing)
- Select: "L" Login
- Type password: "██████" (not case sensitive), this brings up BUDL 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}

Check time and date on 48C to agree with computer time  $\pm$  1 minute (**Note:** 48C must be in "Local mode" to make changes).

#### 48C MAIN MENU

- Using the ↓ pushbutton, select INSTRUMENT CONTROLS <ENTER>
  - Using the ↓ pushbutton, select TIME <ENTER>
- Using the ↑, ↓, ←, and → pushbuttons, move cursor to change number(s), <ENTER>

## **B) Calibration Check Procedure**

40 CFR 58 Appendix A requires at least one precision check (9 ppm) performed every two weeks (14 days).

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) as follows:

## **C) Zero (Ø) Calibration Check Procedure**

Disable Channels on PDL and BUDL Data Logger

- While disabled, values are collected but flagged as invalid data
- Procedure:
  - {ESC} to Home Menu & Select "C" Configuration Menu <ENTER>
  - Select: "D" Configure Data Channel
  - Select: "M" Disable/Mark Channel Offline
  - Select: "CO"
  - {ESC} {ESC} to Home Menu
  - Select: "D" Real Time Display <ENTER>
  - Select: "B" Display Last Base Avg: shows the last 1 min average only w/flag "D": Disabled & "C": Calibration, <ENTER>
  - Highlight BUDL and follow the same steps to disable the channel
  - {ESC} {ESC} to Home Menu on both PDL & BUDL

### **a. Run Calibration (Ø) Check, 0 ppm Carbon monoxide**

When 48C is in **REMOTE** mode, screen should read "**Sample Time Remote**".

- The 8816 data logger will be set up to run a Span Ø.
- Procedure: (To setup Zero Span through 8816 PDL)
  - {ESC} to Home Menu & Select "C" Configuration Menu
  - Select: "C" Configure Calibration
  - Select: "1" Start a Single Phase Calibration
  - Select: "COCAL <ENTER>
  - Select: "ZERO", <ENTER>
  - Check to see if "Phase Duration" is "1h", hit down arrow, type in 60 min <ENTER>
  - Select: "Start Single Cal" (NOW), <ENTER>
  - {ESC} {ESC} to Home Menu
  - Select: "D" Real Time Display <ENTER>
  - Select: "B" Display Last Base Avg: shows the last 1 min average only w/flag D: Disabled & C: Calibration, <ENTER>
  - 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 CO Ø Event 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 values as follows:

<u>146C</u>	<u>48C</u>	<u>PDL</u>	<u>BUDL</u>
0 ppm	0 ppm ± 0.7	0 ppm ± 0.7	0 ppm ± 0.7

Abort the Zero Span after 5 minute averages have been recorded

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

#### D) Span Calibration Check Procedure

Run Span 1, Span 2, & Span 3

- The 8816 PDL continues in Span Zero while the Calibration Levels are changed. Calibration values should continue to be observed via the PDL & BUDL as well as the Calibrator and Analyzer.
- Procedure
  - Select PDL & select "C" Configuration Menu
  - Select: "C" Calibration Configuration
  - Select: "1" Start a Single Phase Calibration
  - Select: "**COCAL**" <ENTER>
  - Select: "**SPAN1**" <ENTER>
  - Check to see if "Phase Duration" is "1h", hit down arrow, type in 60 min <ENTER>
  - Select: "Start Single Cal (NOW)" <ENTER>
  - {ESC} to Home Menu of PDL
  - Select: "D" Real Time Display
  - Select: "B" Display Last Base Avg: shows the last 1 min average only w/flag "D": Disabled <ENTER>
  - Allow system to equilibrate at 42 ppm and monitor values.
  - 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 values.

<u>146C</u>	<u>48C</u>	<u>PDL</u>	<u>BUDL</u>
0 ppm	0 ppm ± 0.7	0 ppm ± 0.7	0 ppm ± 0.7
42 ppm	42 ppm ± 2.0	42 ppm ± 2.0	42 ppm ± 2.0
18 ppm	18 ppm ± 1.5	18 ppm ± 1.5	18 ppm ± 1.5
9 ppm (Precision pt.)	9 ppm ± 1.0	9 ppm ± 1.0	9 ppm ± 1.0

**Review Each Calibration Point results from the data logger.**

Abort the Span 1 after 5 stable minute averages have been recorded.

- Procedure:
  - {ESC} to Home Menu on PDL
  - Select: "C" Configuration Menu
  - Select: "C" Configure Calibrations
  - Select: "W" Abort Cal
  - Select: **COCAL** press <ENTER>, this stops the calibration
- Repeat above steps for "Span 2" & " Span 3" (**Report Span 3 as Precision Check**)

**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. Separate 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 48C Leak Check**

Equipment Required:

Teflon/stainless steel caps - 1/4"

- a) **Sample Route thru Solenoid:** In order to test for the presence of external leaks around the fittings, plug the "**Probe**" inlet fitting with a cap. From the 48C **MAIN MENU** select "**Diagnostics**", "**Pressure**" to check pressure. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. The flow on the Model 48C 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 probe inlet fitting.

b) **Cal/Span Gas Route thru Solenoid:** Activate solenoid by logging in using the datalogger and activating a zero. From the 48C **MAIN MENU** select **Diagnostics, Pressure** to check pressure. Pressure in millimeters Hg will be displayed. This should be approximately ambient pressure. Plug the "Span" gas inlet fitting with a cap. The flow on the Model 48C 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 span inlet fitting.

**2.9.2.4 Calibration Check Review and END**

<u>Calibration Check</u>	<u>146C</u>	<u>48C</u>	<u>PDL</u>	<u>BUDL</u>
Span Ø	0 ppm	0 ppm ± 0.7	0 ppm ± 0.7	0 ppm ± 0.7
Span 1	42 ppm	42 ppm ± 2.0	42 ppm ± 2.0	42 ppm ± 2.0
Span 2	18 ppm	18 ppm ± 1.5	18 ppm ± 1.5	18 ppm ± 1.5
Span 3 (Precision pt.)	9 ppm	9 ppm ± 1.0	9 ppm ± 1.0	9 ppm ± 1.0

If the data checks are not within the specified limits above, the **Calibration Check is NOT ACCEPTABLE.**

**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:**

<b>Section 2.9.2.2,B</b>	<b>Install a New Teflon Particulate Filter</b>
<b>Section 2.9.2.2,C</b>	<b>Perform a Leak Test on the Model 48C</b>
<b>Section 2.9.2.2, D &amp; E</b>	<b>Calibration Procedure</b>

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

**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. Abort Calibration on PDL**

- Procedure:
  - Highlight PDL and {ESC} {ESC} to Home Menu
  - Select: "C" Configuration Menu
  - Select: "C" Configure Calibrations
  - Select: "W" Abort Cal
  - Select: "COCAL", press <ENTER>: this stops the calibration
  - {ESC} {ESC} to Home Menu (If access is denied, Log on again by pressing {ESC} and type the two character site code and AQM (with no spaces)

**4. Enable Channels on PDL & BUDL**

- {ESC} to Home Menu on PDL and select: "C" Configuration Menu
- Select "D": Configure (Data) Channels
- Select "E": Enable/Mark Channel Online
- Select "CO" and press <ENTER>
- When finished, exit to the "Home Menu", by pressing {ESC} and {ESC}
- Verify the flags are cleared and the channel is enabled by pressing "D" and then "F".
- If the flags are cleared, press {ESC} and {ESC} to go back to the home menu, press "O" to Log out and CTRL-ESC to exit
- Highlight BUDL and follow the above instructions for enabling the CO Channel
- Exit the PDL Split Screen operation
- Repeat procedure for BUDL

**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>.

Check Digtrend scheduler before site exit to ensure polling times are correct and that it is setup to collect data.

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

### **2.9.2.5 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, the yesterday's data, and today's data. If calling on a Monday, retrieve the data for Friday, Saturday, and Sunday data as well.

#### **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.

### **2.9.2.6 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 shall 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.

### **2.9.2.7 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. 40 CFR58 Appendix B defines this point as between 8 and 10 ppm for carbon monoxide. 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.

**2.9.2.8 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.