

Section II: Operator Responsibilities
Sulfur Dioxide QA Plan
Revision 9

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2.8.2.1 Procedures for Operation/Calibration of the Model 43C - SO₂ Monitor

The State of North Carolina operates sulfur dioxide monitors across the state for the purpose of monitoring the ambient SO₂ exposure of the general population. In order to collect accurate, meaningful data the monitors must be operated in a consistent manner. The goal of this document is to establish a continuous, verifiable, defensible record of events with regard to the site and the instrument as required by US EPA, 40 CFR 58.

All original records (records documenting observations, i.e. calibration logbook, electronic log, 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.

The current revision has two major changes to the document (change in terminology and primary data logger) from revision number 7 (September-2001), minor editorial revisions and zero-span procedure clarifications from revision number 8 (September-2005) and includes updates as given in "40 CFR Parts 53 and 58, Revisions to Ambient Air Monitoring Regulations; Final Rule" posted in the Federal Register on Tuesday, October 17, 2006 and effective on December 18, 2006.

In order to apply more descriptive and common terminology across all continuous monitoring QA plans the terms "*precision check*", "*adjusted calibration*", and/or "*unadjusted calibration*" have been replaced. The term CALIBRATION CHECK (formally "precision check") is now used to describe the 14-day visit procedure where the operator performs a "one point QC check (i.e., Span 3) on the calibration but does not change the calibration. The term CALIBRATION describes the procedure by which the instrument is set or reset to a calibration curve. Also, the introduction of the ESC, Model 8816 data loggers as PRIMARY data loggers, prompted this update to the previous QA plan. Mention of "printer" operations and graphing/marketing calibration data have been removed. Equilibration times are suggested for instrument stabilization and calibration.

2.8.2.1.1 Instrumentation and Equipment for Continuous SO₂ Monitoring:

Thermo Environmental 43C SO₂ Analyzer;
Thermo Environmental 146C Dynamic Gas Calibrator;
Certified SO₂ cylinder;
Zero Air Pack;
ESC model 8816 Data Loggers (primary and secondary);
A dedicated site PC; and
Modem.

2.8.2.1.2 Common Continuous Monitoring Principles Applicable to the SO₂ System:

- An initial, manual, adjusted calibration (“CALIBRATION” from this point forward) must be performed during the site start-up.
- Visit the site at least once every two weeks (EVERY 14 DAYS OR LESS).
- During the 14-day visit, perform a CALIBRATION CHECK (formerly “precision check” or “unadjusted calibration”). A CALIBRATION CHECK is to be performed *before* any changes are made to the system. CALIBRATION is required when a CALIBRATION CHECK (formerly “precision check”/ “unadjusted calibration”) fails.
- CALIBRATION (formerly “adjusted calibration”) is required whenever a system’s operation is interrupted (i.e. more than two days without power, physical removal/replacement of system components, or major repairs/maintenance as described in the “calibration” section – 2.8.2.2.6). A “closing calibration” is required at the closure of a site. The instrument should be calibrated at a minimum of once per year (even if running smoothly over that time span).
- The clock times of the components at the site are to be verified, and if needed – corrected, during the 14-day visit. The BUDL and PDL should be within one minute of each other and match NIST clock time (+/- 1 minute) as provided by the NIST time provider in Colorado. The NIST time can be verified by several methods:
 1. Set a watch according to the NIST time the morning a site is visited, NIST time is available at: <http://nist.time.gov/>.
 2. Call Colorado (303) 499-7111 for the time, a long distance call not recommended.
 3. Use the time displayed on a cell phone, most are synched to local NIST time (check against the NIST time before using).
 4. Call ECB and ask for the NIST time.

In addition to the data loggers, the site computer must be set 5 minutes *slower* than the data loggers to ensure that a full hour of data is retrieved/stored by the computer, and in turn by the Head Quarters (HQ) polling computer during regularly scheduled polls. The site computers *will not* be automatically synchronized to/by the HQ polling computer, nor should they be synchronized to a region’s polling computer.

- The site is to be inspected for required maintenance such as: shelter condition, condition of plumbing/lines, compressor and silica gel condition, filter changes, leak testing, backup data collection, data review.
- No checks, that affect data, are to be made during periods of ambient exceedances.

2.8.2.2 OPERATIONAL Checks and CALIBRATION for SO₂ Monitoring Sites

An Initial CALIBRATION (formerly *adjusted calibration*) is performed without doing any prior calibration checks. The filter must be clean.

Perform all of the following checks and adjustments prior to calibration on the 43C analyzer. Document all checks and adjustments in the logbook.

2.8.2.2.1 Site Checks

Upon arrival at the site, observe the outside of the sampling building and probe, looking for vandalism or security breaches. Check the probe outside for an intact screen and any insect nests inside the probe funnel or sample line. **Document all actions in the site logbook.** 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. Check the data loggers for appropriate date/time and concentration readings (see Section 2.8.2.2.6 for specifics). Measure the internal temperature of the building in °C and record in the site log book. Adjust the site thermostat as necessary to maintain the temperature within the 20° to 30°C range. If the temperature cannot be stabilized and controlled within this range, notify the regional chemist and the ECB that corrective action is required. The regional chemist and the Projects and Procedures Branch Supervisor should review the data generated during any "out-of-control" period to determine if the data should be flagged or invalidated.

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. 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 to ensure that insects have not nested in the lines. Particulate matter may also collect in the sample line leading to the instrument. Such restrictions can usually be determined by disconnecting the inlet line leading to the instrument. If pump performance is significantly improved and the inlet filter itself is not loaded with particulate matter, the sample line will require cleaning or replacement. **Record all events in the site logbook.** Notify supervisor and call the ECB for instructions on length of stabilization period and restarting/resetting the data logger if necessary.

Check on Gas Cylinder and 146C Calibrator. Verify that the calibration gas cylinder and calibrator are in certification (calibrator certification is valid for *nine months* and should be indicated on a sticker on the front panel) and document certification dates in logbook. [(If the pressure is less than 500 psig, the ECB should be notified that a new cylinder is required. The delivery of a new cylinder must be coordinated with the region to allow time for the region to perform a calibration check just prior to the installation of the new cylinder. Immediately following the installation of a new cylinder, the region must perform a new calibration (see Section 2.8.2.2.6). Verify that the 146C has the correct cylinder SO₂ concentration stored in memory. **Record all events in the site log book.**

2.8.2.2.2 43C Analyzer and 146C Calibrator Operational Checks

Basic checks of the instrumentation.

Alarm Checks (43C Analyzer and 146C Calibrator)

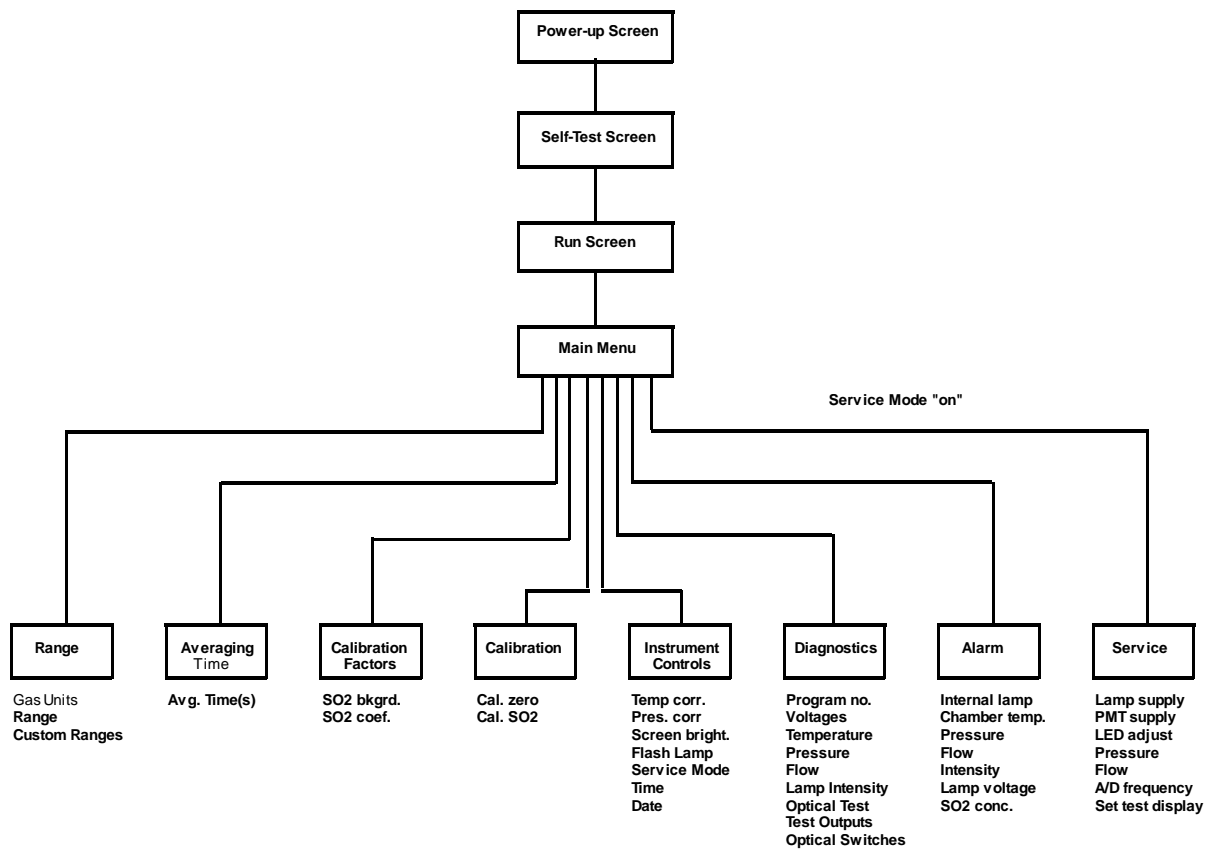
Check the TEI 43C Analyzer Run Screen. If the word **“Remote”** is displayed, press <ENTER> to place in **“Local”** mode. Check the TEI 146C Calibrator Run Screen. If the word **“Remote”** is not displayed, press <ENTER> to place it in **“Remote”** mode (The 146C Calibrator has to be in the REMOTE MODE in order to activate the internal span solenoid inside the 43C Analyzer).

[The Main Menu contains many submenus. Instrument parameters and settings can be found within the submenus according to their function. To select a submenu screen, use the up/down (↑ or ↓) pushbuttons to move cursor up or down, select the submenu and press <ENTER>. No values are to be changed without calling the ECB and getting their approval. If the ECB approves changing a value, document the change in the logbook and follow these steps: To change an incorrect digit (Note: cannot change a value in a view only screen), press the left/right (← or →) pushbuttons to move the underscore to the digit to be changed, and press the ↑ or ↓ pushbuttons to increment or decrement the underscored digit. Press <ENTER> to accept the revised output. To exit a screen, press <MENU> to return to Main Menu and choose another submenu or press <RUN> to return to the Run Screen.]

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:

- 1) Press the <MENU> button on the front of the instrument. (Make sure the 146C Calibrator is in **“Remote”** mode and the 43C Analyzer is in **“Local”** mode.)
- 2) Use the ↑ or ↓ menu pushbuttons to select the **Alarm Submenu**.
- 3) Press the <ENTER> button.
- 4) 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”.
- 5) Press the <ENTER> button.

TEI Model 43C Flow Chart



The following Alarm Limit is used in SO₂ operation of the TEI 146C Calibrators:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Internal Temperature	18.5 °C	47.0 °C

The following Alarm Limits are used in TEI 43C Analyzers:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Internal Temperature	15 °C	35 °C
Chamber Temperature	43 °C	47 °C
Pressure	650 mm Hg	800 mm Hg
Flow	0.35 LPM	0.650 LPM
Lamp Intensity	20,000 Hz	50,000 Hz
Lamp Voltage	600 V	1200 V
SO ₂ Concentration	0 ppb	500 or 1000 ppb

- 6) Determine the cause of the alarm. Consult with the ECB prior to performing calibrations or maintenance.
- 7) Press the <MENU> button twice to return the main menu screen.

Operation Checks (43C Analyzer and 146C Calibrator)

Begin by checking the **Range** the analyzer is set to: 0.2 ppm (200 ppb), 0.5 ppm (500 ppb), or 1.0 ppm (1000 ppb). Choose **Range** from the Main Menu (<MENU> , ↑ or ↓) on the 43C display. The range should be in **Single Range** mode. This range should be identified on red tape on front of monitor. If the monitor range is different than the range specified for the site, contact ECB for the correct instrument/calibration status. (If needed, choose the correct range and calibrate the monitor at that range. Write "**CALIBRATED RANGE (0.2, 0.5, or 1.0) PPM**" on a piece of tape and affix it to the front of the monitor.)

Select the **Diagnostics Menu** (View only screen) and record in the logbook.

Diagnostic checks for the TEI 146 Calibrator:

1. Check current DC voltages for the +5 (±1 volt), +15 (±1 volt), and -15 (±1 volt) power supplies and 3.0 volt for battery.
2. Check internal temperature. (**Note:** Temperature should be between 18.5 and 47.0°C; if outside of these limits, the Alarm would also be flagged.)

Diagnostic checks for the 43C Analyzer:

1. Check current DC voltages for the +5 (±1 volt), +15 (±1 volt), and -15 (±1 volt) power supplies and 3.0 volt for battery.

2. Check internal temperature and chamber temperature (under **Temperature**). (**Note:** Internal temperature should be between 15.0 to 35.0°C and chamber temperature should be between 43.0 to 47.0°; if outside of these limits, the Alarm would also be flagged.)
3. Check pressure (acceptable range is 650 to 800 mmHg).
4. Check the flow (acceptable range 0.350 to 0.650 Liters/minute).
5. Check lamp intensity (acceptable range 20 Khz to 50 Khz).
6. Check the lamp voltage (under **Voltage**) (acceptable range 600 to 1200 V).
7. Check the PMT voltage (also under **Voltage**) to make sure PMT is on (acceptable range -400 to -1200 V).
8. If outside of specified ranges contact ECB. (**Note:** If the lamp voltage is running at or very near to 1200 V it has degraded to it's highest point and may need to be adjusted or changed out. Contact ECB).
9. Verify the averaging time (for the 43C Analyzer) by pressing <MENU>, select **Averaging Time**. Press <ENTER>, verify that AVG Time is set to 60 sec. Press <MENU>, press <RUN>.

Zero Air Pack and Compressor Checks

Verify that the silica gel is not spent as indicated by color change. When the gel is new it is a dark blue or purple color. If the gel is spent, it is a lighter blue or purple color with white crystals. If the gel is spent, replace it and return it to the ECB for regeneration. Verify that the pressure gauge on the Zero Air Supply is reading 20 ± 2 psi. Record reading. Verify and record that the outlet pressure on the air compressor is reading between 30 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).

Cooling Fan and Fan Filters on the 146C and 43C

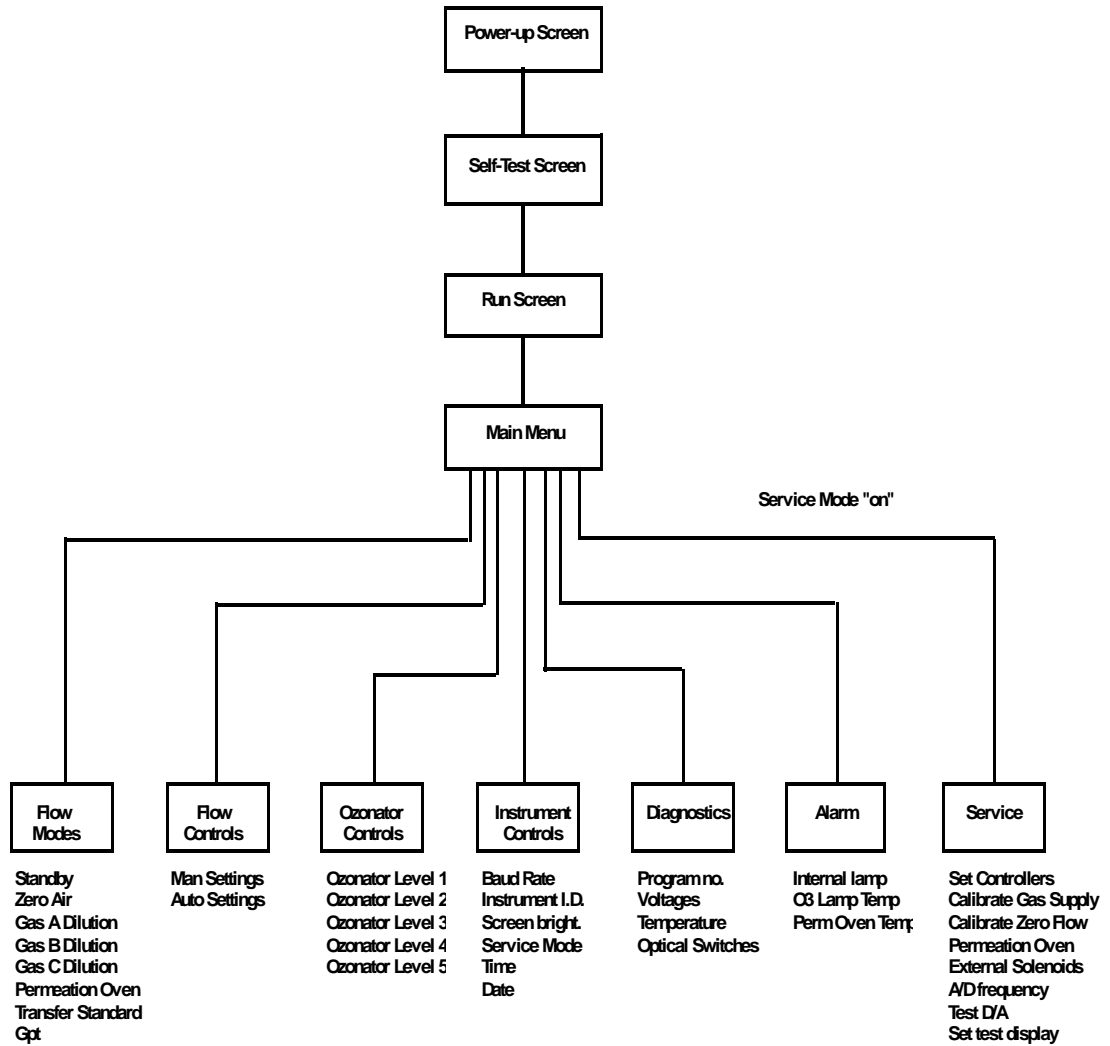
On the back of the instruments there are cooling fans with sponge filters inside. Check to ensure the fans are running. Check to see if the filters are clean during every site visit and clean the filters at least once a month. The fan housing can be popped off the back of the instrument and the filter 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.

2.8.2.2.3 Data Logger Time and Date Checks and Adjustments

The times for the PDL, BUDL, and computer must be EASTERN STANDARD TIME. The BUDL and PDL must have the same time *and* be synched to the NIST time provider in Colorado (± 1 minute). Sources of the NIST time include:

- Cell phones (most are synched to local NIST time, not necessarily “standard” time);
- Calling Colorado (303-499-7111);
- Setting a watch to the NIST website (<http://nist.time.gov/>) within 24hrs of visiting the site;
- Calling ECB and asking for the NIST time.

TEI Model 146C flowchart



The site computer must be set 5 minutes *slower* than the data loggers to ensure that a full hour of data is retrieved/stored during regularly scheduled polling.

Check the data logger time first, then the site computer time (and date). If the DL time is correct, and the PC time is correct (minus 5 minutes), continue 'filter change procedures'. If time or date *is not* within parameters (± 1 minute DL's, -5 minutes PC), reset the offending component(s).

For the PC, "right click" the time in the lower right corner of the windows screen and select <Adjust Date/Time> from the menu options. Correct the time/day and ensure that the time is in "EASTERN STANDARD TIME". Click <OK> to finish.

Open the Primary and Backup Data Logger screens on the computer (shortcut to split screen option on Windows desktop). For the PDL, type in the two-letter site code (front of the PDL) and "AQM" (___ AQM). For the BUDL, type in its two-letter site code (front of the BUDL) and "AQM" (___ AQM). **Note:** the PDL and BUDL have different codes.

For the PDL, log in, <esc><esc><esc>:

- 1) Select "L", (login)
- 2) Type password "██████████" (*highest level password*, this will allow calibration options not otherwise viewable in subsequent steps)
- 3) <ENTER>
- 4) Select "C", (configuration menu)
- 5) Select "S", (system configuration parameters)
- 6) Select "Date-Time"
- 7) <ENTER>

If the date and time is correct continue on to the next task. If it needs to be corrected, type in the correct values and press <ENTER>.

For the BUDL, log in:

- 1) Select "L", (login)
- 2) Type password "██████████"
- 3) <ENTER>
- 4) Select "C", (configuration menu)
- 5) Select "S", (system configuration parameters)
- 6) Select "Date-Time"
- 7) <ENTER>

If the date and time is correct continue on to the next task. If it needs to be corrected, type in the correct values and press <ENTER>.

If a correction to the time and date are made for the computer, PDL, and/or BUDL, document it in the logbook and/or electronic log, including how far off the values were.

2.8.2.2.4 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. **Always change the filter before running a Calibration.** The filter used is a 5.0-micron Teflon filter.

1. Remove the filter holder (if necessary) and disassemble.
2. Remove the existing filter and discard. Remove any extraneous material from filter housing.
3. Touching only the outer edges, place the new filter in the holder (orientation is not critical).
4. Reassemble the filter holder and reattach to instrument in same orientation as before removal (i.e., filter inlet/outlet connected to proper lines). **Do not over tighten the filter holder for this can tear the filter and/or damage the holder.**
5. Perform a leak check to test the integrity of the filter assembly.

2.8.2.2.5 Leak Check Procedure

A Leak Check must be performed after a filter change and/or before a Calibration.

For the Monitor SAMPLE port, the following leak test procedure below should be performed:

1. Disconnect the sample line from the “sample inlet port” on the rear of the instrument and block the opening with a leak-tight cap. (Do not disconnect the lines going to the filter inlet or the filter outlet.)
2. Press “Menu” and move ↑ or ↓ buttons to select “Pressure” and press “Enter”. The pressure reading should drop (flow should also be at zero). Wait until pressure drops below 180 mm Hg.

NOTE: If the pressure has not dropped below 180 mm Hg within three minutes, immediately remove the cap. Check to see that all fittings (leak-tight cap, filter housing, and filter inlet/outlet fittings) are tight and input lines are not cracked or broken and retest. Do not cap off the line for more than three minutes or the system may pressurize. If flow or pressures are not acceptable, the *leak check fails*. Contact the ECB.

3. Remove the cap and document in the logbook.

For the Monitor SPAN port begin the test by running a zero. [ESC: select "C", (configure menu); select "C", (configuration calibration menu); select "1", (single phase phase cal); select "SO2CAL"; select "ZERO"; scroll down to "Phase Duration" and change to 30 m; select "Start Single Cal NOW"] The zero should begin. **The zero must be active to conduct this check.** Then perform the following steps:

1. Disconnect the calibrator line from the calibration gas inlet port on the rear of the 43C Analyzer and connect it to the sample inlet port on the rear of 43C. Block off the calibration gas inlet port on the back of the 43C with a leak-tight cap.

2. Press **Menu** and move \uparrow and \downarrow buttons and select **Pressure** and press “**Enter**”. The pressure reading should be dropping (flow should also go to zero). Wait until pressure drops below 180 mm Hg .

NOTE: If the pressure has not dropped below 180 mm Hg within three minutes, the leak check has failed. Immediately remove the cap. Check to see that all fittings (leak-tight cap, filter housing, and filter inlet/outlet fittings) are tight and input lines are not cracked or broken and re-test. **Do not cap off the line for more than three minutes or the system may pressurize.** If flow or pressures are not acceptable, and/or the *leak check fails* for any reason, contact the ECB before proceeding with the calibration procedure.

3. If the leak check passes, remove the cap, reconnect the calibrator line to the span port and the sample line to the sample inlet. Clear the zero mode by aborting the zero cal.
4. Document in the logbook.

2.8.2.2.6 Calibration

CALIBRATION, when the monitor is operable, is only performed **after** a failed CALIBRATION CHECK and a filter change (*initial calibration excepted*). Document all checks and adjustments in the logbook / e-log.

A CALIBRATION *must* be performed when a major system or component is replaced or fixed/maintained. Major systems are defined as:

- the analyzer,
- the calibrator,
- and the SO₂ cylinder.

Major components that can be replaced and/or maintained include flow controllers, circuit boards, lamps, and solenoids. (If the zero air system is replaced, a zero-precision-span check should be performed and compared to the last z-p-s to verify that the points are equivalent. The zero check should be ± 0.003 ppm for the 1.0 ppm range and ± 0.002 ppm for the 0.2 and 0.5 ppm ranges. For cylinder replacement, a pre-calibration check and post calibration is required. Therefore, arrangements with the ECB for delivery should be scheduled in advance.

A CALIBRATION *must* be performed when the monitoring system’s operation has been interrupted for more than 2 days (as in the case of power outages, or precautionary shutdowns such as hurricanes).

NOTE: Wearing hearing protection is advised while performing any calibration activities due to noise level of the compressor and the length of time spent in this confined space.

NOTE: The PDL and BUDL channels should be "down" from the required checks performed previously (otherwise down the PDL and BUDL channels).

1) **Zero Check:** Run the **Zero Check** (similar to the leak check section). Steps:

- select "C" (Configuration Menu)
- select "C" (Calibration Menu)
- select "1" (start single phase calibration)
- select "SO2CAL"
- select "ZERO"
- scroll down to "Phase Duration" and change from 10 m to 60 m
- select "Start Single Cal NOW"
- <Esc> <Esc> back to home menu
- select "D" (display real-time)
- select "C" (continuous average report)

Allow the monitor and calibrator to stabilize until the primary data logger (PDL) and backup data logger (BUDL) read 0 ± 0.003 ppm on the SO₂ channel for all scale settings. If required, adjust *analyzer* zero setting by doing the following:

1. Press the **Menu** button on the front of the TEI Model 43C analyzer and, using the \uparrow or \downarrow push buttons, move the cursor to select **calibration** menu. Press the **ENTER** button to display the Calibration menu.
2. Select "**Calibrate Zero**" and press the **ENTER** button. The Calibrate Zero screen will appear with the first line of the display showing the current SO₂ reading. With the analyzer producing a stable trace on zero air, press the **ENTER** button to set the SO₂ reading to zero. The lower left-hand corner of the display flashes the message "**Saving parameter(s)**" and the SO₂ reading is added to the background correction.
3. Press the "**Run**" push-button to return to the sample mode.
4. Allow the monitor to stabilize and then **record in the logbook/e-log** the next five one minute Primary Data Logger (PDL) and Back-up Data Logger (BUDL) concentration values (then compute and record the averages of those one minute times and in the logbook).

NOTE: If the PDL is within 0 ± 0.002 ppm on the SO₂ channel for the 0.2 / 0.5 ppm monitor or 0 ± 0.003 ppm for the 1.0 ppm monitor range and the BUDL is not, make a note of it and call the ECB.

2) **Span Procedure:**

Span Check: Run **SPAN 1** (nominally 850 ppb / 400 ppb / 180 ppb depending on location). The span 1 setting is preset to a concentration within the range of "70 to 90% of full scale" of the analyzer's range setting. Allow the 43C to stabilize for a minimum of 20 minutes (**Note: the 1.0 ppm monitors may take longer**). After the monitor has stabilized, the PDL, BUDL, and analyzer outputs should read approximately the "**true**

(146C output display) **concentration**" ± 0.003 ppm. If the 43C analyzer does not match, follow these steps below to adjust the span:

1. Press the **"Menu"** button and select **"Calibration"**. Use the \uparrow and \downarrow to select **"Calibrate SO₂"** and press **"Enter"**. The first line of the display shows the current SO₂ reading, the second line shows the current range and the third line is where the calibration gas concentration is entered.
2. To enter the calibration gas concentration, use the \leftarrow or \rightarrow pushbuttons to move the cursor left and right to select each digit of the SO₂ span concentration. Use the \uparrow and \downarrow buttons to increment and decrement (adjust) each digit to the true SO₂ span concentration.
3. Press **"Enter"** to calibrate the analyzer to the **true** 146C **"Output PPM" display** SO₂ calibration gas concentration. The lower left-hand corner of the display will flash the message "Saving Parameter(s)" and the corrected SO₂ reading is displayed. Press **"Run"** to return to the Run screen.
4. Ensure data logger readings and the TEI 43C display are all reading "approximately" the true SO₂ concentration ± 0.003 ppm. If not, make further adjustments

After the data logger readings and TEI 43C display are all reading approximately the true SO₂ concentration ± 0.003 ppm, allow the monitor to stabilize (a minimum of 10 minutes) and record the next five one minute Primary Data Logger (PDL) values, Back-up Data Logger (BUDL) values, 43C values, and their averages.

CAUTION: DO NOT ADJUST THE SPAN BY ADJUSTING THE PMT! ECB Technicians are the only personnel authorized to make any adjustments to the PMT. Site Technicians MUST adjust the Span by using the "Calibrate SO₂" button (NO EXCEPTIONS).

Re-Run Zero Check: Allow the analyzer to stabilize for a minimum of 10 minutes. After the analyzer has stabilized, the PDL should read 0 ± 0.003 ppm for the 1.0 ppm range and ± 0.002 ppm for the 0.2 and 0.5 ppm ranges. If not, adjust analyzer zero setting by repeating the section on **"Zero Check"**.

Re-Run the Span Check: Allow the analyzer to stabilize for a minimum of 10 minutes. After the analyzer has stabilized, the PDL should read within 0.003 ppm of the expected value for 0.2 ppm range, or within $\pm 5\%$ of the expected value for 0.5 and 1.0 ppm range. Record data in the logbook. If the value is not acceptable, then repeat the section on **"Span Check"**.

3) Multi-Point Procedure:

Begin Multi-Point CALIBRATION : Activate the "ZERO" mode and allow the instruments to stabilize for a minimum of 10 minutes. If the PDL reads 0 ± 0.003 ppm on

the monitor, record 5 one minute zero values (the zero values from the 'zero-check' and the Span values from the 'span-check' may be used if "passing").

Press **Menu** twice, to return to main menu. Use the \uparrow and \downarrow buttons to select **Calibration Factors**, press **Enter**. **NOTE: Make no adjustments.** Record **SO₂ bkg** (background) and **SO₂ coef** (coefficient) in logbook. Press **Menu**, press **Run**.

NOTE: The zero and span interact and may require more than one attempt to meet the above specifications. However, the new combination of the TEI 43C and 146C are more stable than past equipment and therefore the documentation of the adjusted zero and span in this QA/SOP is taken after the initial zero and span adjustments. In most cases, the initial zero and span adjustments will be sufficient for the calibration to pass and additional adjustments will not be necessary. If several (4 or more) zero-span adjustments fail to obtain acceptable responses, call the ECB.

If the **BUDL Zero** does **NOT** agree within 0 ± 0.002 ppm on 0.2 / 0.5 ppm monitor range and 0 ± 0.003 ppm on the 1.0 ppm monitor range; call the ECB.

If **BUDL span** does **NOT** agree with actual concentration within ± 0.003 ppm for any range, and if PDL and BUDL values do not agree within $\pm 3\%$ of each other; log in to BUDL using the highest level password, then make the following BUDL adjustments:

1. Press **Esc** and **Esc**, slowly.
2. Press "**C**" (Configuration Menu), then press "**D**" (Configure Data Channels), then press "**C**" (Change Old Configuration). If these options are not available, you have not logged in with the highest password. Press **Esc** until you reach home menu, then log in again using the highest-level password. **MAKE SURE SCROLL LOCK FUNCTION IS OFF.**
3. Select SO₂ channel and press **Enter**. Select "**High Output**" for span (calibration) upper range limit. The Engineering Units (or E.U.) entered here are concentrations units such as ppm or ppb.
4. To determine a new value to enter here consider the following example:
If the instrument is calibrated on a 0 to 5 ppb range the "zero" and "high" outputs on the PDL should be set to 0 and 5 respectively as well as the BUDL. If the BUDL output, in normal running mode, displays different concentration values than the PDL, such as -0.1 and 4.9 for zero and span, then new E.U. values need to be entered in the BUDL. Considering the calibration range to be a sliding fixed scale, the difference between 0 and 5 is 5 as is the difference between -0.1 and 4.9. The difference between the two zero readings is 0.1 and the difference between the two span readings is 0.1. To adjust the BUDL, change the **Zero Output** from 0.0 to 0.1 and change the **High Output** from 5.0 to 5.1.

5. Press **Enter** several times until **Finished Configuration** is highlighted and press **Enter**. Turn **ON** the Scroll Lock function key on the keyboard, and press **“Page Up”** until the full “Channel Configuration Menu” is visible.
6. Press **“Scroll Lock”** to turn off the scroll lock function, then press **“Esc”** and **“Esc”**. Review and retest zero and span concentrations as needed. This BUDL adjustment may need to be repeated until the BUDL SO₂ channel is reading the true SO₂ concentration (0.002 on 0.5 ppm and 0.003 on 1.0 ppm.) (**After several tries, call the ECB if you still do not get acceptable BUDL values.**)
7. If finished, Select **“D”** (real time data), and Press **“B”** (last base averages).

Introduce other Calibration Points: Run Span 2 and Span 3. Allow a minimum of 10 minutes for each point to stabilize. Record the 146C “Output PPM” displayed SO₂ Actual Concentration (Ca), and the five one-minute PDL, and BUDL responses in the logbook.

Review each SO₂ Calibration Point result from the data logger. For each point calculate the % difference as follows:

$$\% \text{ Difference} = \frac{C_{DL} - C_{ACT}}{C_{ACT}} \times 100$$

where: C_{DL} = Average Concentration from data loggers (PDL and BUDL)

C_{ACT} = Actual Concentration (146C “Output PPM” Display)

Record each result in the logbook. **The zero on the PDL and BUDL must be within ± 3 ppb of the true value on the 1.0 ppm range and must be within ± 2 ppb of the true value on the 0.5 and 0.2 ranges. The concentration displayed on PDL and BUDL for Span 1 and Span 2 must be within $\pm 5\%$ of the true value for the 1.0 and 0.5 ppm ranges and ± 3 ppb for the 0.2 ppm range.** (See Table 1 for a Summary of the Acceptance Criteria and Table 2 for Calibration Concentration Ranges)

Table 1. Acceptance Criteria for Calibrations and QC Checks

Calibration Gas	Zero			Span 1			Span 2			Span 3		
Instrument Range, ppm	<u>1.0</u>	<u>0.5</u>	<u>0.2</u>	<u>1.0</u>	<u>0.5</u>	<u>0.2</u>	<u>1.0</u>	<u>0.5</u>	<u>0.2</u>	<u>1.0</u>	<u>0.5</u>	<u>0.2</u>
Full Calibration	± 3 ppb	± 2 ppb	± 2 ppb	$\pm 5\%$	$\pm 5\%$	± 3 ppb	$\pm 5\%$	$\pm 5\%$	± 3 ppb	$\pm 5\%$	± 3 ppb	± 3 ppb
14 Day QC Check	± 3 ppb	± 3 ppb	± 3 ppb	NA	NA	NA	NA	NA	NA	$\pm 5\%$	± 3 ppb	± 3 ppb

If any calibration points are not within specification with respect to the C_{ACT} values, the calibration is not acceptable and must be re-run to identify and correct any problems. If a second attempt to calibrate fails, contact the ECB for guidance.

Table 2. SO₂ Calibration Ranges

<u>Instrument Range, ppm</u>	<u>1.0</u>	<u>0.5</u>	<u>0.2</u>
Span 1, ppm (70-90 % of Full Scale)	0.700-0.900	0.350-0.450	0.140-0.180
Span 2, ppm (40-50% of Full Scale)	0.400-0.500	0.200-0.250	0.080-0.100
Span 3, ppm (16-20% of Full Scale)	0.010-0.100 ^A	0.080-0.100	0.032-0.040
Zero	0.0	0.0	0.0

^ASpan 3 (Precision/QC Check must be between 10 and 100 ppb regardless of % of span

2.8.2.2.7 End

Review the logbook calibration numbers and “up” the PDL and BUDL channels. Go to the Home Menu (by pressing “ESC” several times if needed):

1. Highlight the PDL or BUDL,
2. Select “C” (Configuration Menu),
3. Select “D” Configure (Data Channels),
4. Select “E” Enable/Mark Channel Online,
5. Select “SO₂” and Press <ENTER>.

When finished, exit to the “Home Menu”, by pressing <Esc> and <Esc>. Verify that 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” (Log out) and CTRL-ESC to exit. Exit the Split Screen operation.

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.

Note: Remember to sign out and reset the scheduler for normal operation.

2.8.2.3 Calibration Check

The purpose of calibration is to correlate the output of a monitoring system with known, traceable concentrations of SO₂. The Calibration Check is a manually initiated response check of the instrument’s calibration and is referred to as a “One Point QC Check”. This was formerly called an *unadjusted calibration*.

Visit the site at least once every two weeks (EVERY 14 DAYS OR LESS) to perform a CALIBRATION CHECK. Perform a CALIBRATION CHECK prior to any maintenance or scheduled interruption of monitor operation lasting more than 48 hours as discussed under Section 2.8.2.2.6. (Maintenance that *does not* affect calibration are sample inlet line replacement and particulate filter replacement.) If a CALIBRATION CHECK *fails*, a CALIBRATION (formerly “adjusted calibration”) *must be* performed. **No checks that affect data are to be made during periods of ambient exceedances.**

2.8.2.3.1 Site Checks

Upon arrival at the site, observe the outside of the sampling building and probe, looking for vandalism or security breaches. Check the probe outside for an intact screen and any insect nests inside the probe funnel or sample line. **Document all actions in the site logbook.** 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. Check the data loggers for appropriate date/time and concentration readings (see Section 2.8.2.2.6 for specifics). Measure the internal temperature of the building in °C and record in the site log book. Adjust the site thermostat as necessary to maintain the temperature within the 20° to 30°C range. If the temperature cannot be stabilized and controlled within this range, notify the regional chemist and the ECB that corrective action is required. The regional chemist and the Projects and Procedures Branch Supervisor should review the data generated during any “out-of-control” period to determine if the data should be flagged or invalidated.

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. 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 to ensure that insects have not nested in the lines. Particulate matter may also collect in the sample line leading to the instrument. Such restrictions can usually be determined by disconnecting the inlet line leading to the instrument. If pump performance is significantly improved and the inlet filter itself is not loaded with particulate matter, the sample line will require cleaning or 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 that the calibration gas cylinder and calibrator are in certification (calibrator certification is valid for *nine months* and should be indicated on a sticker on the front panel) and document certification dates in logbook. If the pressure **is less than 500 psig**, the ECB should be notified that a new cylinder is required. The delivery of a new cylinder must be coordinated with the region to allow time for the region to perform a calibration check just prior to the installation of the new cylinder. Immediately

following the installation of a new cylinder, the region must perform a new calibration (see Section 2.8.2.2.6). Verify that the 146C has the correct cylinder SO₂ concentration stored in memory. **Record all events in the site logbook.**

2.8.2.3.2 43C Analyzer and 146C Calibrator Operational Checks

Basic checks of the instrumentation.

Alarm Checks (43C Analyzer and 146C Calibrator)

Check the TEI 43C Analyzer Run Screen. If the word “**Remote**” is displayed, press <ENTER> to place in “**Local**” mode. Check the TEI 146C Calibrator Run Screen. If the word “**Remote**” is not displayed, press <ENTER> to place it in “**Remote**” mode (The 146C has to be in the REMOTE MODE in order to activate the internal span solenoid inside the 43C).

[The Main Menu contains many submenus. Instrument parameters and settings can be found within the submenus according to their function. To select a submenu screen, use the up/down (↑ or ↓) pushbuttons to move cursor up or down, select the submenu and press <ENTER>. No values are to be changed without calling the ECB and getting their approval. If the ECB approves changing a value, document the change in the logbook and follow these steps: To change an incorrect digit (Note: cannot change a value in a view only screen), press the left/right (← or →) pushbuttons to move the underscore to the digit to be changed, and press the ↑ or ↓ pushbuttons to increment or decrement the underscored digit. Press <ENTER> to accept the revised output. To exit a screen, press <MENU> to return to Main Menu and choose another submenu or press <RUN> to return to the Run Screen.]

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:

- 1) Press the <MENU> button on the front of the instrument. (Make sure the 146C is in “**Remote**” mode and the 43C is in “**Local**” mode.)
- 2) Use the ↑ or ↓ menu pushbuttons to select the **Alarm Submenu**.
- 3) Press the <ENTER> button.
- 4) 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”.
- 5) Press the <ENTER> button.

The following Alarm Limit is used in the SO₂ operation of the TEI 146C Calibrators:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Internal Temperature	18.5°C	47.0°C

The following Alarm Limits are used in TEI 43C Analyzers:

<u>Parameter</u>	<u>Min.</u>	<u>Max.</u>
Internal Temperature	15 °C	35 °C
Chamber Temperature	43 °C	47 °C
Pressure	650 mm Hg	800 mm Hg
Flow	0.35 LPM	0.650 LPM
Lamp Intensity	20,000 Hz	50,000 Hz
Lamp Voltage	600 V	1200 V
SO ₂ Concentration	0 ppb	500 or 1000 ppb

- 6) Determine the cause of the alarm. Consult with the ECB prior to performing calibrations or maintenance.
- 7) Press the <MENU> button twice to return the main menu screen.

Operation Checks (43C Analyzer and 146C Calibrator)

Begin by checking the **Range** the analyzer is set to, 0.2 ppm (200 ppb), 0.5 ppm (500 ppb), or 1.0 ppm (1000 ppb). Choose **Range** from the Main Menu (<MENU> , ↑ or ↓) on the 43C display. The range should be in **Single range** mode. This range should be identified on red tape on the front of the monitor. If the monitor range is different than the range specified for the site, contact ECB for the correct instrument/calibration status. (If needed, choose the correct range and calibrate the monitor at that range. Write "**CALIBRATED RANGE (0.2, 0.5 or 1.0) PPM**" on a piece of tape and affix it to the front of the monitor.)

Select the **Diagnostics Menu** (View only screen) and record in the logbook.

Diagnostic checks for the TEI 146C Calibrator:

1. Check current DC voltages for the +5 (±1 volt), +15 (±1 volt), and -15 (±1 volt) power supplies and 3.0 volt for battery.
2. Check internal temperature. (**Note:** Temperature should be between 18.5 and 47.0°C; if outside of these limits, the Alarm would also be flagged.)

Diagnostic checks for the 43C Analyzer:

1. Check current DC voltages for the +5 (±1 volt), +15 (±1 volt), and -15 (±1 volt) power supplies and 3.0 volt for battery.
2. Check internal temperature and chamber temperature (under **Temperature**). (**Note:** Internal temperature should be between 15.0 to 35.0°C and chamber temperature should be between 43.0 to 47.0°; if outside of these limits, the Alarm would also be flagged.)
3. Check pressure (acceptable range is 650 to 800 mmHg).
4. Check the flow (acceptable range 0.350 to 0.650 Liters/minute).
5. Check lamp intensity (acceptable range 20 Khz to 50 Khz).
6. Check the lamp voltage (under **Voltage**) (acceptable range 600 to 1200 V).

7. Check the PMT voltage (also under **Voltage**) to make sure PMT is on (acceptable range -400 to -1200 V).
8. If outside of specified ranges contact ECB. (**Note:** If the lamp voltage is running at or very near to 1200 V it has degraded to it's highest point and may need to be adjusted or changed out. Contact ECB).
9. Verify the averaging time (for the 43C) by pressing <MENU>, select **Averaging Time**. Press <ENTER>, verify that AVG Time is set to 60 sec. Press <MENU>, press <RUN>.

Zero Air Pack and Compressor Checks

Verify that the zero air system is in certification (1 year) and that the silica gel is not spent by color change. When the gel is new it is a dark blue or purple color. If the gel is spent, it is a lighter blue or purple color with white crystals. If the gel is spent, replace it and return it to the ECB for regeneration. Verify that the pressure gauge on the Zero Air Supply is reading 20 psi \pm 2 psi. Record reading. Verify and record that the outlet pressure on the air compressor is reading between 30 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).

Cooling Fan and Fan Filters on the 146C and 43C

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. 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.**

2.8.2.3.3 Data Logger Time and Date Checks and Adjustments

The times for the PDL, BUDL, and computer must be EASTERN STANDARD TIME. **NOTE!! The BUDL and PDL must match the N.I.S.T. time \pm 1 minute. The site PC should be set 5 minutes *slower* than the DL's N.I.S.T. time.** The NIST time can be verified by several methods:

- Set a watch according to the NIST time the morning a site is visited; NIST time is available at: <http://nist.time.gov/>.
- Call Colorado (303) 499-7111 for the time, a long distance call not recommended.
- Use the time displayed on a cell phone, most are synched to local NIST time (check against the NIST time before using).
- Call ECB and ask for the NIST time.

The site computer is set 5 minutes *slower* than the data loggers to ensure that a full hour of data is retrieved/stored by the computer, and in turn by the HQ polling computer during regularly scheduled polls. The site computers *will not* be automatically synchronized to/by the HQ polling computer, nor should they be synchronized to a region's polling computer.

Check the computer time and date at the lower right hand corner of the computer screen. If the time and date are correct, continue to the data loggers. If the time or date *is not* correct, “right click” the time and select <Adjust Date/Time> from the menu options. Correct the time/day and ensure that the time is in “EASTERN STANDARD TIME”. Click <OK> to finish.

Open the Primary and Backup Data Logger screens on the computer (shortcut to split screen option on Windows desktop). For the PDL, type in the two-letter site code (front of the PDL) and “AQM” (___ AQM). For the BUDL, type in its two-letter site code (front of the BUDL) and “AQM” (___ AQM). **Note:** the PDL and BUDL have different codes.

For the PDL, log in, <esc><esc><esc>:

- 1) Select “**L**”, (login)
- 2) Type password “XXXXXXXXXX” (*highest level password*, this will allow calibration options not otherwise viewable in subsequent steps)
- 3) <ENTER>
- 4) Select “**C**”, (configuration menu)
- 5) Select “**S**”, (system configuration parameters)
- 6) Select “**Date-Time**”
- 7) <ENTER>

If the date and time are correct continue on to the next task. If they need to be corrected, type in the correct values and press <ENTER>.

For the BUDL, log in:

- 1) Select “**L**”, (login)
- 2) Type password “XXXXXXXXXX”
- 3) <ENTER>
- 4) Select “**C**”, (configuration menu)
- 5) Select “**S**”, (system configuration parameters)
- 6) Select “**Date-Time**”
- 7) <ENTER>

If the date and time are correct continue on to the next task. If they need to be corrected, type in the correct values and press <ENTER>.

If the correct time and date are not indicated for the computer, PDL, and/or BUDL, they should be corrected and **documented in the logbook**.

2.8.2.3.4 Calibration Check Procedure

If the monitor is operable, a CALIBRATION CHECK must be performed **prior** to any component changes, alignments, or CALIBRATION (with the exception of the initial adjusted calibration). **Make no monitor adjustments before the Calibration Check.** Hearing

protection should be worn while performing any calibration activities due to the noise level of the compressor in this confined space. Conduct a Calibration Check as follows:

- 1) Log into the computer if needed (type your user name, "*initials*"; and password, "██████"). Choose "Shortcut to Split Screen" on the Windows desktop or from the ESC main menu select "**Utilities**". Select "**Login**", Double Click on "**SPLIT SCREEN**"; the PDL should be displayed on the top half of the monitor and the BUDL on the lower half.
- 2) Log into the PDL.
<Esc>
type "site code AQM" (example **MLAQM**)
<ENTER>
select "**L**"
type password "██████████" (*highest level password*)
<ENTER>
- 3) Down the PDL.
<Esc> back to return to Home Menu
select "**C**" (configuration menu)
select "**D**" (configure data channels)
select "**M**" (mark channels down/ off)
highlight SO2
<ENTER>
- 4) Log into the BUDL.
<Esc>
type "site code AQM" (example **MLAQM**)
<ENTER>
select "**L**"
type password "██████"
<ENTER>
- 5) Down the BUDL.
<Esc> back to return to Home Menu
select "**C**" (configuration menu)
select "**D**" (configure data channels)
select "**M**" (mark channels down/ off)
highlight SO2
<ENTER>
- 6) View the PDL.
<Esc> back to return to Home Menu
select "**D**" (display real-time)

select “**B**” (base average one minute)
updated data should display a (D) indicating the 'downed' channel

7) View BUDL.

<Esc> back to return to Home Menu
select “**D**” (display real-time)
select “**B**” (base average one minute)
updated data should display a (D) indicating the 'downed' channel

8) Run the **ZERO CHECK**.

<Esc> back to return to Home Menu
select “**C**” (Configuration Menu)
select “**C**” (Calibration Menu)
select “**1**” (start single phase calibration)
select “**SO2CAL**”
select “**SPAN0**”
scroll down to “Phase Duration” and change from 10 m to 60 m
select “Start Single Cal NOW”
<Esc> <Esc> back to home menu
select “**D**” (display real-time)
select “**B**” (display last base average)

9) View BUDL Zero.

select “**D**” (display real-time)
select “**B**” (display last base average)-

Allow the monitor to stabilize (at least a minimum of 10 minutes) and then **record in the logbook** the next five one minute Primary Data Logger (PDL) and Back-up Data Logger (BUDL) concentration values. Also record the True 146C “Output PPM” Concentration from the calibrator display. Calculate the average of each.

10) Run **SPAN 1** (nominally 850 ppb / 400 ppb / 180 ppb depending on location). The Span 1 setting is preset to a concentration within the range of "70 to 90% of full scale" of the analyzer's range setting.

11) Run **SPAN 2** (nominally 450 ppb / 250 ppb / 100 ppb). The Span 2 setting is preset approximately to "40 to 60% of full scale" of the analyzer's range setting.

12) Run **Span 3** (also known as the 14-day “one point QC check” and previously as the “precision point”). The concentration of this gas must be between 10 and 100 ppb. For the 1.0 and 0.5 ppm range instruments this value will be nominally 90 ppb and for the 0.2 ppm range instruments this value will be nominally 36 ppb.

Review each calibration check point result from the data logger. For each point calculate the % difference as follows:

$$\% \text{ difference} = \frac{C_{DL} - C_{ACT}}{C_{ACT}} \times 100$$

where: C_{DL} = Average Concentration from data loggers (PDL and BUDL)
 C_{ACT} = Actual Concentration (146C "Output PPM" Display)

Record each result in the logbook. **The zero on the PDL and BUDL must be within ± 3 ppb of the true value on the 1.0 ppm range and must be within ± 2 ppb of the true value on the 0.5 and 0.2 ranges. The concentration displayed on PDL and BUDL for Span 1 and Span 2 must be within ± 5 % of the true value for the 1.0 and 0.5 ppm ranges and ± 3 ppb for the 0.2 ppm range.** (See Table 1 for a Summary of the Acceptance Criteria.)

If the Calibration Check is acceptable, and if the nightly auto span concentration has not changed, proceed to "Filter Change Procedure". If the span calibration check points *are not* within the required ranges of the C_{ACT} values, then conduct the *required CALIBRATION* (adjusted).

STOP ZERO / ABORT CALIBRATION ON PDL

highlight PDL , and <ESC>, <ESC> to (Home Menu)

select "C" (Configuration Menu)

select "C" (Configure Calibrations)

select "W" (Abort Calibration) (NO: OOC, REC, STORE) ???

SO2CAL press <ENTER>, this stops the calibration

<ESC>, <ESC> to (Home Menu)

ENABLE CHANNELS ON PDL & BUDL

highlight the PDL,

select "C" (Configuration Menu)

select "D" Configure (Data Channels)

Select "E" Enable/Mark Channel Online

Select "SO2" and Press <ENTER>

highlight BUDL, and repeat the instructions for enabling the SO2 channel

2.8.2.3.5 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. Always change the filter *before* running a Calibration. The filter used is a 5.0-micron Teflon filter.

1. Remove the filter holder (if necessary) and disassemble.
2. Remove the existing filter and discard. Remove any extraneous material from the filter housing.
3. Touching only the outer edges, place the new filter in the holder (filter orientation is not critical).
4. Reassemble the filter holder and reattach to the instrument in the same orientation as before removal (i.e., filter inlet/outlet connected to proper lines). **Do not over tighten the filter holder for this can tear the filter and/or damage the holder.**
5. Perform a leak check to test the integrity of the filter assembly.

2.8.2.3.6 Leak Check Procedure

The Leak Check must be performed after a filter change or Calibration Check, whether the filter has been changed or not.

For the Monitor SAMPLE port, the following leak test procedure below should be performed:

1. Disconnect the sample line from the “sample inlet” port on the rear of the instrument and block the inlet with a leak-tight cap. (Do not disconnect the tubing going to the filter inlet or the filter outlet).
2. Press “Menu” and move ↑ or ↓ buttons to select “Pressure” and press “Enter”. The pressure reading should drop (flow should also be at zero). Wait until pressure drops below 180 mm Hg .

NOTE: If the pressure has not dropped below 180 mm Hg within three minutes, immediately remove the cap. Check to see that all fittings are tight (leak-tight cap, filter housing, and filter inlet/outlet fittings) and input lines are not cracked or broken and retest. Do not cap off the line for more than three minutes or the system may pressurize. If flow or pressures are not acceptable, the *leak check fails*. Contact the ECB.

3. Remove the cap and document in the logbook.

For the Monitor SPAN port begin the test by running a zero. [ESC: select "C", (configure menu); select "C", (configuration calibration menu); select “1”, (single phase phase cal); select “SO2CAL”; select “ZERO”; scroll down to “Phase Duration” and change to 30 m; select “Start Single Cal NOW”.] The zero should begin. **The zero must be active to conduct this check.** Then perform the following steps:

1. Disconnect the calibrator line from the calibration inlet port on the 43C and connect it to the sample inlet port on the rear of the instrument. Block off the span port on the back of the 43C with a leak-tight cap.

2. Press **Menu** and move \uparrow and \downarrow buttons and select **Pressure** and press “**Enter**”. The pressure reading should be dropping (flow should also be at zero). Wait until pressure drops below 180 mm Hg .

NOTE: If the pressure has not dropped below 180 mm Hg within three minutes, the leak check has failed. Immediately remove the cap. Check to see that all fittings (leak-tight cap, filter housing, and filter inlet/outlet fittings) are tight and input lines are not cracked or broken and re-test. **Do not cap off the line for more than three minutes or the system may pressurize.** If flow or pressures are not acceptable, and/or the *leak check fails* for any reason, contact the ECB before proceeding with the calibration procedure.

3. If the leak check passes, remove the cap; reconnect the calibrator line to the span port and the sample line to the sample inlet. Clear the zero mode by aborting the zero cal.
4. If the **filter was changed**, run a span point for ten minutes to ensure the filter does not leak. The instrument should read the span. Abort the span and allow the monitor to purge itself of span gas and start sampling ambient air again. Document in the logbook.

2.8.2.3.7 Back-up Data and End

Every month, the Data Management and Statistical Services Branch (DMSSB) initiates a data review by printing a raw data report for each field office. Each month, it may be requested of the Regional Offices to send additional instances of BUDL data that are needed beyond what DMSSB requires for verifying the missing value imputations supplied by the field office.

Whichever files are summoned, will be FTP'd to the central office by the same deadline that is established for returning the raw data review. ***Backup data loggers are to be stored to disk as follows:***

1. Open the BUDL window,
2. Log in, password <[REDACTED]>.
3. Select <**Utilities**>.
4. Select <**Copy File**>.
5. Select <**Data Files**>.
6. Select <**Minute Data**>.
7. Select <**Range**>.
8. Select the <**Start Date**>.
9. Select the <**End Date**>.
10. Select the drive to copy the data to.
11. Insert a disk / zip disk / CD into the drive.
12. Select <**Copy**>.

Label the storage medium with the following information: site, month data was recorded, date backup was created, operator name.

Review the logbook calibration numbers and “up” the PDL and BUDL channels. Go to the Home Menu (by pressing "**ESC**" several times if needed);

1. Highlight the PDL or BUDL,
2. Select "**C**" (Configuration Menu)
3. Select "**D**" Configure (Data Channels)
4. Select "**E**" Enable/Mark Channel Online
5. Select "**SO2**" 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**" (Log out) and **CTRL-ESC** to exit. Exit the Split Screen operation.

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.

For further information on data handling and Region/Operator responsibilities proceed to Section 2.8.3, “Regional Office Responsibilities: Data Retrieval Data Review, Data Correction Report Submission”