A SITE OPERATIONAL PROCEDURES

A.1 Introduction

A major factor in ensuring high quality data from the Automatic Urban Monitoring Network will be the regular visits to each monitoring site carried out by locally based personnel. These site visits will allow the following functions to be undertaken:

(1) Precalibration checks;

(2) Changing particulate monitor filter;

(3) Calibration of analysers;

(4) Postcalibration checks, safety and security inspection.

Together with these routine fortnightly functions, there will be instances when non-routine site visits will be necessary, in the event of apparent instrument or system malfunction.

Local site operators have been trained in all aspects of normal equipment operation by the MU unit, and in the relevant calibration procedures by the QA/QC unit. Operators must retain copies of instrument manuals at each site, and are required to familiarise themselves with normal operating principles and characteristics of the instrumentation.

Calibration procedures differ from instrument to instrument, but the basic principle is common to all analyser types, with the exception of the particulate analyser. As described in Chapter 10, weekly calibrations will take the form of a simple two-point calibration. More detailed instrument tests will be undertaken by QA/QC unit personnel, in combination with the 6 monthly instrument intercalibration and servicing exercise (see Section 13).

Each analyser must be calibrated exactly *as found*. In this way, any instrumental drifts which may have occurred since the previous calibration will be exactly quantified, with there being no possibility that changes in response have been caused by any operator action.

Acting only on advice from the MU, instrument adjustments may be performed to optimise analyser sensitivity. If such adjustments are found to be necessary, the instrument will be recalibrated after a suitable initial stabilisation period, typically 15 minutes, so allowing the production of provisional revised calibration factors. However, full stabilisation of the instrument may take several hours and hence, ideally the instrument should be recalibrated after a further 24 hours. The MU will advise on this. It is not anticipated that instrument adjustments of this sort will occur frequently.

The following sections of the manual describe step-by-step procedures which must be followed during site visits. It is essential that the procedures are followed as written, for fortnightly and non-routine site visits, to ensure that reliable and accurate air quality measurements are made. However, the sequence in which zero and span calibrations are performed is not critical.

A.2 Preparation

1. Upon arrival at the site, check the pollutant levels on the front panel of each analyser and the chart trace (if present), to see if an episode is occurring i.e. pollution levels during the last hour are above, or close to, the trigger values as discussed in Section 10.6 (O_3 >~70 ppb, NO_2 >~75 ppb, SO_2 >~90 ppb and CO >~10 ppm). If an episode is occurring phone the MU before proceeding any further.

2. Using the Automated calibration sheets, enter Full Site Name (as there may be several different sites in one city), Date, Local Site Operator and Start Time.

3. Ensure the Site Operators Manual is to hand, and follow the instructions carefully.

A.3 Precalibration Checks

In this section, a number of initial visible checks are made on the equipment. Some checks require a tick and some require a value to be recorded on the precalibration sheet. Complete all the checks for all the analysers and ancillary equipment. When all checks are complete proceed with the calibration, inform the MU if any checks are not correct.

A.3.1 CO Analyser

The APMA-370 CO analyser has a full graphic LCD touch screen that, via a system of menus, can display a variety of analyser information such as pollutant concentration and system error messages. In addition, control of the calibration of the site analyser is undertaken via the system calibration menu. A screen saver function on the analyser automatically turns the screen off when no key has been pressed for 30 minutes, touching the LCD touch screen will turn the screen on.

1. In normal operation, the analyser should be displaying the current ambient CO concentration, the Mode field showing "**MEAS**", the correct time and date should be displayed on the top line of the display, and the padlock symbol showing it as locked. Check the status of the analyser display and record the various parameters on the precalibration checklist.

2. The alarm indicator is a small LED light situated to the bottom left of the LCD display. This should be showing green if everything is OK with the analyser. If the LED is showing red then it is possible that a system malfunction has occurred. To view this fault select the "**alarm**" button on the touch screen display and note down the fault onto the calibration sheet. To exit Alarm page select "**Close**" on the display.

3. The analyser monitors several important pieces of information about its current operation. Of these, sample flow and various reaction cell parameters are of particular interest. To find these parameters you must first unlock the front screen by selecting the "**Padlock**" symbol situated top right of the LCD touch screen display. Next select "**key Unlock**", then insert the password of "**1234**" and select "**Set**". The padlock symbol will now appear open and a Spanner Icon will flash showing that the analyser is out of service. The Alarm indicator will also turn red. To access Pre Calibration Parameters first select the "**Menu**" button, then scroll using the cursor icon to the "**Maintenance**" page, and select "**Analog Input**". From here take down all appropriate parameters (stated in the pre calibration sheet) found within "**Analog Output 1/2**" and "**Analog Output 2/2**". Select "**Close**" until you return to the front screen.

A.3.2 NO_X Analyser

The APMA-370 NO_x analyser has a full graphic LCD touch screen that, via a system of menus, can display a variety of analyser information such as pollutant concentration and system error messages. In addition, control of the calibration of the site analyser is undertaken via the system calibration menu. A screen saver function on the analyser automatically turns the screen off when no key has been pressed for 30 minutes, touching the LCD touch screen will turn the screen on.

1. In normal operation, the analyser should be displaying the current ambient NO, NO_2 and NO_X, concentration, the Mode field will show "**MEAS**", and the correct time and date should be displayed on the top line of the display, and the padlock symbol showing it as locked. Check the status of the analyser display and record the various parameters on the precalibration checklist.

2. The alarm indicator is a small LED light situated to the bottom left of the LCD display. This should be showing green if everything is OK with the analyser. If the LED is showing red then it is possible that a system malfunction has occurred. To view this fault select the "**alarm**" button on the touch screen display and note down the fault onto the calibration sheet. To exit Alarm page select "**Close**" on the display.

3. The analyser monitors several important pieces of information about its current operation. Of these, sample flow and various reaction cell parameters are of particular interest. To find these parameters you must first unlock the front screen by selecting the "**Padlock**" symbol situated top right of the LCD touch screen display. Next select "**key Unlock**", then insert the password of "**1234**" and select "**Set**". The padlock symbol will now appear open and a Spanner Icon will flash showing that the analyser is out of service. The Alarm indicator will also turn red. To access Pre Calibration Parameters first select the "**Menu**" button, then scroll using the cursor icon to the "**Maintenance**" page, and select "**Analog Input**". From here take down all appropriate parameters (stated in the pre calibration sheet) found within "**Analog Output 1/2**" and "**Analog Output 2/2**". Select "**Close**" until you return to the front screen.

A.3.3 SO_2 Analyser

The APMA-370 SO_2 analyser has a full graphic LCD touch screen that, via a system of menus, can display a variety of analyser information such as pollutant concentration and system error messages. In addition, control of the calibration of the site analyser is undertaken via the system calibration menu. A screen saver function on the analyser automatically turns the screen off when no key has been pressed for 30 minutes, touching the LCD touch screen will turn the screen on.

1. In normal operation, the analyser should be displaying the current ambient SO_2 concentration, the Mode field showing "**MEAS**", the correct time and date should be displayed on the top line of the display, and the padlock symbol showing it as locked. Check the status of the analyser display and record the various parameters on the precalibration checklist.

2. The alarm indicator is a small LED light situated to the bottom left of the LCD display. This should be showing green if everything is OK with the analyser. If the LED is showing red then it is possible that a system malfunction has occurred. To view this fault select the "**alarm**" button on the touch screen display and note down the fault onto the calibration sheet. To exit Alarm page select "**Close**" on the display.

3. The analyser monitors several important pieces of information about its current operation. Of these, sample flow and various reaction cell parameters are of particular interest. To find these parameters you must first unlock the front screen by selecting the "**Padlock**" symbol situated top right of the LCD touch screen display. Next select "**key Unlock**", then insert the password of "**1234**" and select "**Set**". The padlock symbol will now appear open and a Spanner Icon will flash showing that the analyser is out of service. The Alarm indicator will also turn red. To access Pre Calibration Parameters first select the "**Menu**" button, then scroll using the cursor icon to the "**Maintenance**" page, and select "**Analog Input**". From here take down all appropriate parameters (stated in the pre calibration sheet) found within "**Analog Output 1/2**" and "**Analog Output 2/2**". Select "**Close**" until you return to the front screen.

A.3.4 Ozone Analyser

The APMA-370 O_3 analyser has a full graphic LCD touch screen that, via a system of menus, can display a variety of analyser information such as pollutant concentration and system error messages. In addition, control of the calibration of the site analyser is undertaken via the system calibration menu. A screen saver function on the analyser automatically turns the screen off when no key has been pressed for 30 minutes, touching the LCD touch screen will turn the screen on.

1. In normal operation, the analyser should be displaying the current ambient O_3 concentration, the Mode field will show "**MEAS**", and the correct time and date should be displayed on the top line of the display, and the padlock symbol showing it as locked. Check the status of the analyser display and record the various parameters on the precalibration checklist.

2. The alarm indicator is a small LED light situated to the bottom left of the LCD display. This should be showing green if everything is OK with the analyser. If the LED is showing red then it is possible that a system malfunction has occurred. To view this fault select the "**alarm**" button on the touch screen display and note down the fault onto the calibration sheet. To exit Alarm page select "**Close**" on the display.

3. The analyser monitors several important pieces of information about its current operation. Of these, sample flow and various reaction cell parameters are of particular interest. To find these parameters you must first unlock the front screen by selecting the "**Padlock**" symbol situated top right of the LCD touch screen display. Next select "**key Unlock**", then insert the password of "**1234**" and select "**Set**". The padlock symbol will now appear open and a Spanner Icon will flash showing that the analyser is out of service. The Alarm indicator will also turn red. To access Pre Calibration Parameters first select the "**Menu**" button, then scroll using the cursor icon to the "**Maintenance**" page, and select "**Analog Input**". From here take down all appropriate parameters (stated in the pre calibration sheet) found within "**Analog Output 1/2**" and "**Analog Output 2/2**". Select "**Close**" until you return to the front screen.

A.3.5 TEOM Particulate Monitor

The R & P TEOM instrument has a 4 line display screen, as shown in Figure D6 Appendix D. The top line displays, from left to right, current status code, current operating mode, percentage of filter lifetime used, current RS-232 mode and current time. This top line is fixed, whilst the other 3 lines of the display can be used to scroll through a list of 16 information lines displaying various parameters. Use the cursor keys on the keypad to scroll up and down.

The switch and the light marked "POWER" and "STATUS" respectively are mounted on the TEOM control unit front panel.

Record the following checks on the precalibration checklist.

1. In normal operation, the "POWER" switch will be on and the "STATUS" light off. Check these and record on the precalibration checklist.

2. Record current status code, current operating mode, percentage of filter lifetime used, current RS-232 mode and current time from the top line of the display.

3. Record the first three information lines in the appropriate space on the precalibration checklist.

4. Press ↓ to scroll through all information lines and record the information.

5. Press ↑ to return to the top of the information lines.

A.3.6 Air Sampling Manifold (where fitted)

Record the following checks on the precalibration checklist.

1. Check that the sample manifold is intact and shows no sign of possible leakage.

2. Check that the blower motor is operating by listening and feeling for vibration on the motor housing. If the manifold is HORIBA supplied the LED on the blower casing should be lit.

3. Check that the instrument sample inlet tubes are connected to the manifold and the sample inlet port at the back of the rack and that these connections are secure.

A.3.7 Modem (where visible/fitted)

1. Check that the modem is powered and record on the precalibration checklist.

A.3.8 Data Logger (where fitted)

Air monitoring stations differ in that some record data from analysers using a discrete data logger (often recording analyser analogue output voltages), whereas other stations record data on the analysers internal logging system.

Exact procedures are dependent on the type of logger present, contact your MU for specific instructions.

A.3.9 Chart Recorder (where fitted)

Exact procedures are dependent on the make and model of the chart present. Contact your MU if advice is required, the generic checks that should be made are;

1. Check that the chart is in record mode

2. Check that the traces are clearly visible on the chart paper.

3. Inspect the chart paper to see that it is not jammed.

A.3.10 Zero Air Generator

Check the condition of the scrubbers, two of which are self indicating; silica gel turns from orange to clear and purafil from purple to brown as it becomes exhausted. A diagram of a typical zero air generator is shown in Figure D5.

1. Check that at least 25% of the silica gel is still orange. If less than 25% of the silica gel is orange proceed to section A.3.11 - Changing the Silica Gel.

2. Check that at least 25% of the purafil is still purple. If less than 25% of the purafil is purple, note on the calibration record sheet, but continue with calibration.

3. Check that all connections are secure and tight.

A.3.11 Changing the silica gel

The materials within the zero air generator will be changed at six-monthly intervals during equipment service. If it is necessary to change the silica gel the exact procedures are dependent on the design of the zero air generator. Contact the MU for further advice.

A.3.12 Completion of Precalibration Checks

If any of the above checks are not correct, inform the MU before proceeding with calibration.

If all correct, proceed to section A.4.

A.4 TEOM Particulate Monitor

The TEOM particulate monitor filter cartridge must be changed either every 4 weeks or when the "percentage of filter lifetime used", as shown on the top line of the instrument display is 80% or greater. It is recommended that the TEOM filter cartridge box is stored in the sensor unit of the TEOM analyser so they are pre-conditioned before they are changed with existing filters.

Whenever the filter cartridge is changed, the PM_{10} head must be cleaned as detailed below. Since the analyser requires at least one hour to stabilise after filter cartridge changing, it is recommended that this operation be undertaken before the calibration of the gas analysers. Whenever the filter is changed, complete the TEOM Filter Cartridge record sheet.

A.4.1 Cleaning the PM_{10} Head

The PM_{10} head is located on the sample inlet tube above the roof of the monitoring station. Use the ladder, with due regard to personal safety, to gain access to the cabinet roof. Extra care should be taken if raining as the roof of the cabinet may be slippery when wet.

The PM_{10} inlet needs to be cleaned each time the TEOM filter cartridge is changed to ensure optimal performance. The cleaning materials required are a small brush, lint free tissues, cotton buds, Decon 90 (1% in H_2O), silicon grease, and distilled water. All components are to be cleaned by soaking Decon 90 on lint-free tissues or cotton buds as appropriate. The component should then be rinsed with distilled water to remove any Decon 90 and wiped dry with a lint-free tissue.

A.4.2 Removing the PM_{10} Head

1. Switch the TEOM 'out of service'. This is achieved by pressing the 'DATA STOP' button on the TEOM control unit.

2. Carefully lift the complete PM_{10} head assembly from the TEOM inlet tube.

3. Protect the inlet tube so that rain or snow cannot enter at any time whilst the head is removed, and take the head inside the monitoring cabinet.

4. Separate the upper and lower inlet halves by unscrewing (counter-clockwise) the acceleration assembly from the collector assembly (see Fig. D7).

A.4.3 Cleaning the Acceleration Assembly

1. Mark the upper and lower plates of the assembly with a pencil so that the unit can be correctly aligned on reassembly.

2. Unscrew the four Philips screws from the top plate and remove the top plate and four spacers.

3. Clean the top plate, deflector cone, insect screen, internal walls and the underside plate.

4. Inspect the large diameter o-ring for wear and replace if necessary. Wipe any grease off with a tissue, and apply a thin coating of fresh silicon grease to the o-ring and the aluminium threads.

5. Careful reassemble, using the pencil marks to align the top and bottom plates.

A.4.4 Cleaning the Collector Assembly

1. Clean the walls, the three vent tubes and the base of the assembly with a lint-free cloth soaked in Decon 90. Rinse with distilled water.

2. Use cotton buds and Decon 90 to clean the three vent tubes, base of the assembly and weep hole in the collector plate where the moisture runs out to the moisture trap. Rinse with distilled water.

3. Disconnect rain jar assembly from lower collector plate assembly. Clean inside brass tube with cotton buds and Decon 90. Rinse with distilled water.

4. Remove the rain jar and clean. For units with a cork-sealing ring inside the cap of the jar, put a thin coating of silicon grease on the gasket and install the jar. If the sealing gasket is neoprene, no silicon grease is required.

5. Reconnect rain jar assembly to lower collector assembly. Ensure rain jar is sitting vertically.

6. Inspect the two inlet tube o-rings for wear and replace if necessary. Wipe off any grease present, and apply a thin coating of fresh silicon grease to the o-rings.

7. Clean the internal threads of the assembly with Decon 90 on a lint-free tissue.

A.4.5 Replacing the Head

1. Screw the Acceleration and Collector assemblies together until the threads are hand tight. DO NOT OVER-TIGHTEN

2. Place the complete assembly back onto the TEOM inlet tube.

A.4.6 Filter Cartridge Exchange Procedure

1. Refer to Figs D8 and D9 when following the instructions for filter exchange. It is recommended that the TEOM filter cartridge box is stored in the sensor unit of the TEOM analyser so they are pre-conditioned before changing.

2. Switch the TEOM 'out of service'. This is achieved by pressing the 'DATA STOP' button on the TEOM control unit.

3. Open the door of the TEOM sensor unit.

4. Carefully lift the handle of the mass transducer to swing the transducer into its filter changing position and expose the filter.

5. Carefully insert the filter exchange tool under the filter cartridge so that the filter disk is between the fork and the upper plate of the tool (with the hub of the filter between the tines of the lower form). Gently lift the filter from the tapered element with a straight pull - DO NOT TWIST OR PULL SIDEWAYS.

6. Discard the exposed cartridge and wipe clean the exchange tool with a tissue.

7. Use the exchange tool to remove a new cartridge from the box - DO NOT TOUCH THE FILTER WITH YOUR FINGERS. Note that the box of new filters should be stored inside the TEOM sensor unit, to maintain them at a constant temperature.

8. Hold the new filter in line with the tapered element and lightly insert the hub of the filter onto the tip of the tapered element. Apply a downward pressure to set the filter firmly in place and then carefully retract the exchange tool. Problems with excessive response noise may be experienced if the filter is not seated correctly and firmly on the tip of the tapered element. The filter should, therefore, be positioned with particular care.

9. Gently move the horizontal handle downward to close the mass transducer; allow the springs to pull it closed for the last centimetre.

10. Close the door of the TEOM sensor unit.

11. After 5 minutes, open the sensor unit and mass transducer again and push down on the filter with the base of the exchange tool. This is to ensure that no movement of the cartridge has occurred during heating of the transducer.

12. Close the door of the TEOM sensor unit.

13. Press <F1> on the TEOM control unit and allow one hour for system to reset.

14. The TEOM analyser will automatically return to its in service mode (Mode 4), check that the TEOM has successfully reached this status (this should have taken no more than 1 hour).

15. Check that TEOM noise level on the chart recorder trace (where present) is within 60 $\mu g/m^3$ (~7 vertical chart divisions). If greater than this, attempt to re-seat the filter. If still excessively noisy or the TEOM has failed to return to Mode 4, contact the MU.

A.5 Analyser Calibration Procedure

Results of the calibration will be taken from both the data logger display (if present) and the instrument's display and recorded on the calibration record sheets. The on-site chart recorder (if present) is to be used to determine that the instrument has fully stabilized in its response to the gas sample being introduced at its inlet.

When closing the gas cylinder valves care should be taken not to overtighten the valves on the gas regulator. Overtightening can damage the needle valve mechanism resulting in the outlet valve failing to open. The main valve on the top of each cylinder should, however, be tightly closed to avoid venting the cylinder. Where autocalibration systems use solenoid valve switching of the site cylinders (as opposed to permeation devices) the cylinders should already be on before calibration starts and should be left on.

In order to have a full and complete set of instructions for each analyser, instructions for opening gas cylinder valves are contained within the calibration procedure for each analyser. However, when all analysers are being calibrated, it will be advantageous for all cylinders to be opened at the same time, after ensuring that any needle valves in the cabinet are closed. All cylinders can then be closed, if necessary, at the same time at the end of the calibration session.

A.5.1 CO Analyser

The two-point calibration of a carbon monoxide analyser will be carried out as follows:

1. Record the instrument serial number on the calibration record sheet.

2. The analyser is automatically flagged as "**out of service**" when the analyser is unlocked. This prevents calibration data being disseminated as ambient concentrations.

3. On the LCD touch screen display select "**CAL**", then "**MEAS**", then "**ZERO**". Select "**SET**" to initiate the zeroing of the analyser.

4. Note the concentrations down after 6 minutes or after the readings have stabilised (the value should not vary by more than ± 0.2ppm)

5. Record three consecutive CO readings from the data logger (where present) and instrument display, i.e. after thirty second intervals record the value from the analyser display.

6. Before initiating the Span cycle, record the cylinder pressure from the dial closest to the cylinder head and cylinder number from tag on cylinder, and enter these on the calibration record. Do not use the cylinder if the pressure indicated is less than 300 psi. In this event contact the MU.

7. Initiate the Span sequence by selecting "**ZERO**" on the Cal front screen, then "**SPAN**" on the LCD touch screen display. Select "**SET**" to initiate SPAN sequence.

8. Allow the analyser to stabilise on span gas for a period of not less than 6 minutes or after the analyser has stabilised (the value should not vary by more than ± 0.4ppm).

9. Record three consecutive CO readings from the data logger (where present) and instrument display, i.e. after thirty-second intervals record the value from the analyser display.

10. To exit calibration menu select "**SPAN**", then "**MEAS**", then "**SET**", then "**CLOSE**" to go back to front screen.

11. Check that the analyser returns to normal ambient concentrations (you can use the value you recorded during the analysers precalibration checks as a rough indication of ambient values, bearing in mind that at strongly traffic related sites these concentrations may vary over fairly short timescales).

12. By considering previous calibration results, satisfy yourself that the calibration has proceeded successfully. The zero value should not differ by more than ~0.25 ppm from the previous calibration. The span calibration value should not differ by more than 5% from that obtained during the previous calibration. If in doubt, repeat the relevant procedure. If the results of this are also unsatisfactory, contact the MU.

13. Change the CO sample inlet filter, following the instructions given in section A.5.5.

A.5.2 NOx Analyser

The two-point calibration of the oxides of nitrogen analyser will be carried out as follows:

1. Record the instrument serial number on the calibration record sheet.

2. The analyser is automatically flagged as "**out of service**" when the analyser is unlocked. This prevents calibration data being disseminated as ambient concentrations.

3. On the LCD touch screen display select "**CAL**", then "**MEAS**", then "**ZERO**". Select "**SET**" to initiate the zeroing of the analyser.

4. Note the concentrations down after 6 minutes or after the readings have stabilised (the value should not vary by more than ± 2ppb). Also note down the instrument gain values for zero and span. These are situated under "ZERO" and "SPAN" on the Cal front page beside "SPAN CONC.".

5. Record three consecutive NO_x, NO, and NO_2 readings from the data logger (where present) and instrument display, i.e. after thirty second intervals record the value from the analyser display.

6. Before initiating the Span cycle, record the cylinder pressure from the dial closest to the cylinder head and cylinder number from tag on cylinder, and enter these on the calibration record. Do not use the cylinder if the pressure indicated is less than 300 psi. In this event contact the MU.

7. Initiate the Span sequence by selecting "**ZERO**", then "**SPAN**" on the LCD touch screen display. Select "**SET**" to initiate SPAN sequence.

8. Allow the analyser to stabilise on span gas for a period of not less than 6 minutes or after the analyser has stabilised (the value should not vary by more than ± 2ppb).

9. Record three consecutive NO_x, NO, and NO_2 readings from the data logger (where present) and instrument display, i.e. after thirty-second intervals record the value from the analyser display.

10. Repeat steps 1 to 9 using the on-site NO_2 calibration cylinder. The NO signal should be close to that obtained while performing the zero calibration. The NOx and NO2 signals should show the same approximate large deflection.

11. To exit calibration menu select "**SPAN**", then "**MEAS**", then "**SET**", then "**CLOSE**" until back to front screen.

12. Check that the analyser returns to normal ambient concentrations (you can use the value you recorded during the analysers precalibration checks as a rough indication of ambient values, bearing in mind that at strongly traffic related sites these concentrations may vary over fairly short timescales).

13. By considering previous calibration results and the chart recorder trace obtained from the calibration just performed, satisfy yourself that the calibration has proceeded successfully. The zero value should not differ by more than ~4ppb from the previous calibration. The span calibration value should not differ by more than 5% from that obtained during the previous calibration. If in doubt, repeat the relevant procedure. If the results of this are also unsatisfactory, contact the MU.

14. Change the NO_x sample inlet filter, following the instructions given in section A.5.5.

A.5.3 SO_2 Analyser

The two-point calibration of a sulphur dioxide analyser will be carried out as follows:

1. Record the instrument serial number on the calibration record sheet.

2. The analyser is automatically flagged as "**out of service**" when the analyser is unlocked. This prevents calibration data being disseminated as ambient concentrations.

3. On the LCD touch screen display select "**CAL**", then "**MEAS**", then "**ZERO**". Select "**SET**" to initiate the zeroing of the analyser.

4. Note the concentrations down after 6 minutes or after the readings have stabilised (the value should not vary by more than ±2ppb)

5. Record three consecutive SO_2 readings from the data logger (where present) and instrument display, i.e. after thirty second intervals record the value from the analyser display.

6. Before initiating the Span cycle, record the cylinder pressure from the dial closest to the cylinder head and cylinder number from tag on cylinder, and enter these on the calibration record. Do not use the cylinder if the pressure indicated is less than 300psi. In this event contact the MU.

7. Initiate the Span sequence by selecting "**ZERO**", then "**SPAN**" on the LCD touch screen display. Select "**SET**" to initiate SPAN sequence.

8. Allow the analyser to stabilise on span gas for a period of not less than 6 minutes or after the analyser has stabilised (the value should not vary by more than ±2ppb).

9. Record three consecutive SO_2 readings from the data logger (where present) and instrument display, i.e. after thirty-second intervals record the value from the analyser display.

10. To exit calibration menu select "**SPAN**", then "**MEAS**", then "**SET**", then "**CLOSE**" until back to front screen.

11. Check that the analyser returns to normal ambient concentrations (you can use the value you recorded during the analysers precalibration checks as a rough indication of ambient values, bearing in mind that at strongly traffic related sites these concentrations may vary over fairly short timescales).

12. By considering previous calibration results and the chart recorder trace obtained from the calibration just performed, satisfy yourself that the calibration has proceeded successfully. The zero value should not differ by more than ~4 ppb from the previous calibration. The span calibration value should not differ by more than 5% from that obtained during the previous calibration. If in doubt, repeat the relevant procedure. If the results of this are also unsatisfactory, contact the MU.

13. Change the SO_2 sample inlet filter, following the instructions given in section A.5.5.

A.5.4 Ozone Analyser

The two-point calibration of an ozone analyser will be carried out as follows:

1. Record the instrument serial number on the calibration record sheet.

2. The analyser is automatically flagged as "out of service" when the analyser is unlocked. This prevents calibration data being disseminated as ambient concentrations.

3. On the LCD touch screen display select "**CAL**", then "**MEAS**", then "**ZERO**". Select "**SET**" to initiate the zeroing of the analyser.

4. Note the concentrations down after 6 minutes or after the readings have stabilised (the value should not vary by more than ±2ppb). Also note down the instrument gain values for zero and span. These are situated under "ZERO" and "SPAN" on the Cal front page beside "SPAN CONC.".

5. Record three consecutive O_3 readings from the data logger (where present) and instrument display, i.e. after thirty second intervals record the value from the analyser display.

6. Initiate the Span sequence by selecting "**ZERO**", then "**SPAN**" on the LCD touch screen display. Select "**SET**" to initiate SPAN sequence.

7. Allow the analyser to stabilise on span gas for a period of not less than 6 minutes or after the analyser has stabilised (the value should not vary by more than ±2ppb).

8. Record three consecutive O_3 readings from the data logger (where present) and instrument display, i.e. after thirty-second intervals record the value from the analyser display.

9. To exit calibration menu select "**SPAN**", then "**MEAS**", then "**SET**", then "**CLOSE**" until back to front screen.

10. Check that the analyser returns to normal ambient concentrations (you can use the value you recorded during the analysers precalibration checks as a rough indication of ambient values,

bearing in mind that at strongly traffic related sites these concentrations may vary over fairly short timescales).

11. By considering previous calibration results and the chart recorder trace obtained from the calibration just performed, satisfy yourself that the calibration has proceeded successfully. The zero value should not differ by more than ~4 ppb from the previous calibration. The span calibration value should not differ by more than 5% from that obtained during the previous calibration. If in doubt, repeat the relevant procedure. If the results of this are also unsatisfactory, contact the MU.

12. Change the O_3 sample inlet filter, following the instructions given in section A.5.5.

A.5.5 Changing Analyser Sample Inlet Filters

The analyser sample inlet filters situated on the front of the instrument rack will be changed on a fortnightly basis at all sites. In the event of a filter appearing badly soiled, the site operator shall inform the MU.

Detailed instructions for sample inlet filter changing:

1. Open the analyser front panel by pressing down right side of the panel (front right), the analyser panel swings open with a door action hinged on the left.

2. The sample filter is situated on the centre or right of the analyser unit, mounted in a vertical orientation for ease of access.

3. Turn the filter cover anticlockwise and then remove.

4. Remove the sample filter.

5. Inspect filter for signs of excessive soiling and inspect the gasket and o-ring to ensure they are not damaged.

6. Take clean filter from box and insert into the filter holder (careful not to dislodge/lose the gasket and o-ring under the sample filter). **On the APMA and APNA (CO and NO_X) the notched face of the gasket should be pointing outwards. Otherwise leaks will occur.**

7. Replace the filter cover.

A.6 Postcalibration Checks, Safety and Security Inspection

As the AURN will report time-averaged concentration data, it is important that operators critically assess the operating condition of the analysers over the time scales used in making discrete measurements. Such assessments may not be possible by consideration of averaged data, as the averaging process may mask such factors as excessive noise or cyclic response changes etc. Information on analyser performance over very short time periods is important, as this will alert network managers as to whether instrumentation faults are developing.

Performing calibration checks at fortnightly intervals, as detailed previously, is an excellent means of assessing instrument performance characteristics. For instance, excessive rise or fall times, possibly due to flow constrictions having developed, will be easily noted by a simple calibration of the analyser. Similarly, "noisy" analyser outputs, which may be caused by inefficient photomultiplier tube cooling systems, will be immediately apparent by observing the analyser output while sampling zero air.

Operators will also be expected to examine backup chart recorder traces (where present) whilst on-site. These again may highlight problems which are not apparent by consideration of telemetry data. Considering each trace in turn, the operator should verify that the traces are as normally expected. The trace should show some degree of variation with time. For instance, in the case of primary pollutants such as NO_X and CO, there should normally be a peak corresponding to the morning rush hour. Pollutants such as NO_X and CO would be expected to rise and fall in phase with each other, whereas NO_X and O_3 traces would generally be out of phase. The operator should verify that a continuous trace is being recorded i.e. there are not excessively high levels of instrument noise, and that any daily zero span autocalibration cycle has taken place. The chart traces for the autocalibrations should be examined closely to verify that the instrument fully stabilises on both zero and span gas during the autocalibration cycle. In addition, seemingly unimportant occurrences, such as an analyser air pump being noisy, may be indicative that the unit is liable to malfunction; this should be reported by the operator.

Obviously, the level to which these problems will be detected will depend upon the experience and familiarity with the equipment of each individual operator,

but the operator must critically review the calibration he/she has undertaken and comment on any unusual or suspect results or occurrences. In addition, the postcalibration check sheet must be completed as follows:

1. All checks detailed in section A.3 must now be repeated and recorded on the postcalibration check sheet as follows:

   CO Analyser

   NO_X Analyser

   SO_2 Analyser

   Ozone Analyser

   TEOM (not required when filter not changed)

   Air Sampling Manifold (not required if precalibration was OK)

   Modem

   Data Logger (where applicable)

   Chart Recorder (if present)

2. Complete the final check section of the postcalibration check sheet. Ensure that the Analyser is back in "Mode: MEAS" on the front screen.

3. Put the analyser back into service (if not done so already) by selecting the "**Padlock**" icon in the top right of the touch screen, select "**Key Lock**", then "**Close**". This will bring you back to the front screen.

3. Complete the calibration end time.

4. Inspect the cabinet inside and outside for security and safety purposes, paying particular attention to electrical and telephone connections. Check for any signs of vandalism, especially if this may affect safety or lead to deterioration in data quality. Immediate action must be taken to rectify any situation, which may lead to members of the public or monitoring personnel being at risk.

5. Check that the roof area and any fittings are secure, that there are no loose items left on the roof and then stow the ladder safely inside the hut.

6. Where applicable check that all cylinders are firmly closed and the cylinder store locked (Note: if the cylinders are used for autocalibration purposes, via solenoid control, the cylinders must be left on).

7. Ensure the cabinet is clean and tidy.

8. Upon completion of the calibration and on returning to your office, photocopy the entire completed checklists and calibration sheets. These copies should be faxed to:

   - the network MU, fax number 0207 261 1425
   - the network QA/QC unit, fax number 0870 190 6610.

10. Keep the copies at your office and when you next visit the site return the original calibration sheets to the monitoring site, where they should be stored in a file. In this way a backup will be kept of the calibration history of all the instruments on site. The network QA/QC unit will remove site calibration records at the six monthly intercalibration visits.