

SECTION 6 SITE OPERATIONAL PROCEDURES, R&P TEOM 1400

PARTICULATE ANALYSER

1 Introduction

Some sites within the AURN are still equipped with R&P TEOM 1400 particle analysers, although these are gradually being upgraded to FDMS units. This document describes LSO procedures for the TEOM analyser, which may be included in a site equipped with any make of gaseous analysers.

A major factor in ensuring high quality data from the Automatic Urban and Rural 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) Pre-calibration checks;
- (2) Changing the particulate monitor filter (if applicable);
- (3) Postcalibration checks, safety and security inspection.

Together with these routine 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 will be trained in all aspects of normal equipment operation by the MU, 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.

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 both routine and non-routine site visits, to ensure that reliable and accurate air quality measurements are made.

2 Preparation

1. Upon arrival at the site, check the pollutant levels on the front panel of each analyser) to see if an episode is occurring i.e. pollution levels during the last hour are about $100\mu\text{g}/\text{m}^{-3}$
2. Take a new set of check and calibration sheets and enter Site, Date and Operator and Start Time.
3. Ensure the Operational Manual is to hand, and follow the instructions carefully.
4. Ensure that the site toolkit (if provided) is complete.
5. If out of service switches are not fitted at the site the MU should be telephoned upon arrival. This will allow them to ensure that calibration data is not disseminated as ambient data.

3 Pre-calibration 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, inform the MU if any are not correct, before proceeding with the calibration.

3.1 TEOM Particulate Monitor

The R & P TEOM instrument has a 4 line display screen, as shown in Figure D6 Appendix D. The top line is fixed, and displays, from left to right, current status code, current operating mode, percentage of filter lifetime used, current RS-232 mode and current time. 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.

Two lights marked "POWER" and "STATUS" are also visible on the front panel.

Record the following information 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. Telephone the MU if the time displayed differs by more than 5 minutes from **Greenwich Mean Time**.
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.
6. Carry out a visual check that the PM₁₀ head is intact.

3.2 Modem (where fitted)

1. Check that the lights on the modem are lit, the 25 way connector is secure, and the phone line is plugged into the BT socket. Record on the precalibration checklist. It is likely that the communications for the TEOM are incorporated into that for the other site analysers.

3.3 Completion of Precalibration Checks

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

If all correct, proceed to section 4.

4 TEOM Particulate Monitor

The TEOM particulate monitor filter cartridge must be changed every 2/4 weeks (As advised by your MU) 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 PM₁₀ 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.

4.1 Cleaning the PM₁₀ Head

The PM₁₀ 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 monitoring station roof. Extra care should be taken if raining as the roof of the station may be slippery when wet.

The PM₁₀ 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 H₂O), 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.

4.2 Removing the PM₁₀ Head

1. Switch the TEOM "out of service" switch to ON. If no switch has been explicitly fitted the 'Data Stop' button must be pressed.

2. Carefully lift the complete PM₁₀ 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 station.
4. Separate the upper and lower inlet halves by unscrewing (counter-clockwise) the acceleration assembly from the collector assembly (see Fig. D7, Appendix D).

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.

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.

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.

4.6 Filter Cartridge Exchange Procedure

1. Refer to Figs D8 and D9 (Appendix D) 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. Inform the MU when the site stock of unused filters reach four.
2. Check that the TEOM 'out of service' switch/'Data Stop' button is ON.
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 gentle 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 downwards 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 . The TEOM will move through its operational modes as internal parameters stabilise. Check the noise value at the bottom of the display reads <0.1 after 10 minutes. If this is not the case reseal the filter. If this does not reduce the 'noise' sufficiently return to A.4.2.1 and repeat the whole procedure. If this is not successful inform the MU immediately.

14. Switch the TEOM 'out of service' switch to 'off'. If no out of service switches are fitted the TEOM will return to service automatically on reaching mode 4. If this is not successful inform the MU immediately.

5 Post-calibration Checks, Safety and Security Inspection

As the AUN reports 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 analyser noise or cyclic response changes. Information on analyser performance over very short time periods is important, as this will alert network managers and the QA/QC Unit as to whether instrumentation faults are developing.

Performing calibration checks at regular scheduled 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.

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 for the TEOM detailed in section A.3 must now be repeated and recorded on the postcalibration check sheet.
2. Complete the final check section of the postcalibration check sheet. If "out of service" switches are not fitted telephone the MU to notify them that the calibration is complete so that they may restore data dissemination.
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 a 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 fittings are secure, that there are no loose items left on the roof and stow any site ladder safely inside the monitoring station.
6. Ensure the cabinet is clean and tidy.
7. Upon completion of the calibration and on returning to your office, photocopy the entire check-lists and calibration sheets. These must be faxed immediately to the MU, fax number 0207 261 1425 and also to the QA/QC Unit, fax number 0870 190 6610. Keep the copies at your office and, when you next visit the site return the original calibration sheets to the monitoring site. In this way, a backup will be kept of the calibration history of all the instruments.