



Automatic Urban and Rural Network (AURN) LSO Manual - Appendices

Version 1.2 - November 2022

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We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

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Table of Contents

| | |
|--|----|
| Appendix A - Example of Service Contract Specification For Equipment Support Units (ESUs)..... | 5 |
| 1.1. Specification of Works | 5 |
| Appendix B – Safety Data Sheets for Gases | 14 |
| 1.2. BOC Gas Safety Datasheets | 14 |
| 1.3. Air Liquide Gas Safety Datasheets..... | 14 |
| Appendix C - Gas Regulator Returns Procedure..... | 15 |
| 1.4. Broken or Faulty Regulator..... | 15 |
| 1.5. Return of Regulator Reaching End of Life (EOL)..... | 15 |
| 1.6. Contacts | 16 |
| Appendix D – Gas Regulators | 17 |
| 1.7. Conventional Pressure Regulator..... | 17 |
| 1.8. Selectable Flow Regulator..... | 18 |
| 1.9. Changing a Regulator..... | 18 |
| Appendix E – Glossary of Abbreviations and Conversion Factors..... | 20 |
| 1.10. Conversion Factors – (at 293K and 101.3 kPa)..... | 21 |
| Appendix F – Partisol Checklist and Record Sheet | 22 |
| 1.11. Partisol 2025 Equipment Update: | 22 |
| Would you like to find out more about us or your environment? | 24 |

Updating and Version Control

This manual is a working document, intended to be updated when equipment or procedures change. This manual is provided in electronic format, and the latest version is available on the Health and Safety Database. If you are a Local Site Operator, it is your responsibility to ensure that you download and use the most up to date version.

Version Control Table

| Revision Date | Summary of Changes | Version Number |
|---------------|--|----------------|
| October 2021 | Addition of QAQC e-mail for London sites Addition of Version Control text and table. | 1.1 |
| October 2021 | Addition of reference to the ALN | 1.1 |
| November 2022 | No changes: version number changed for consistency with Parts A, B and C of this Manual. | 1.2 |

Appendix A - Example of Service Contract Specification For Equipment Support Units (ESUs)

Within the AURN there is a subset of sites in and around London, called the Automatic London Network (ALN). In this document, 'AURN' means the whole network, including ALN sites, unless specifically stated otherwise.

Local Authority monitoring stations affiliated into the AURN will need to have a Service and Maintenance contract in place, with a suitable Equipment Support contractor. This Appendix provides an example specification for a service and maintenance contract, for air quality monitoring equipment for the Automatic Urban and Rural and London Networks.

The text below is reproduced from the specification issued to invited tenderers for the service and maintenance contract for the AURN for direct funded AURN equipment and monitoring stations. In this example the servicing and maintenance contract is managed by the Central Management and Coordination Unit (CMCU) and covers a large number of sites.

1.1. Specification of Works

1.1.1. Routine Service and Maintenance

It is a requirement of the AURN to achieve a **minimum** data capture of **90%** for all pollutants across all sites, over the period of a calendar year. (Allowance of a further 5% is also made for planned maintenance). The service and maintenance procedures adopted, and the resources dedicated to them, must be **sufficient to meet** the required data capture target.

Routine servicing of all instruments and equipment at each site is to be carried out on a **six-monthly** basis. The service visits are to be conducted in co-ordination with the QA/QC six-monthly audit visits, and must be completed within a timetable determined by CMCU and QA/QC (typically starting January and July). A schedule of service visits must be provided to CMCU and QA/QC Units in advance and be within the specified QA/QC window. The ESUs must provide a schedule for site service visits to QA/QC and CMCU as a minimum at least two weeks prior to the six-monthly service programme.

The ESU will be responsible for ensuring that all work undertaken on site conforms to the relevant Health and Safety standards and legislation such as, working at heights, electrical safety, use of compressed gases, COSHH and manual handling, etc. CMCU will advise on Health and Safety. It is, however, the ESU's responsibility to put in place procedures for safe working, and to ensure that these are followed. National safety regulations apply, in particular the Management of Health and Safety at Work Regulations (1999) and the Health and Safety at Work etc. Act (1974). The latter applies to all persons connected with work done by the network, whatever their organisation.

It is expected that ESUs will review risks and prepare a risk assessment for work carried out at each site, including transport to and from the site and the movement of gas cylinders into the site. The risk assessment should be submitted via the online form in the health and safety database.

Routine service visits are to include full instrument servicing according to the manufacturer's recommendations. During the service, a number of important equipment

tests must be undertaken. To achieve these, the ESU must own, or have access to, the following test equipment:

- a calibrated ozone photometer able to perform a six point test of an ozone analyser in the range 0 to 250 ppb.
- a gas blender / dilution system able to perform a NO_x converter test at NO₂ concentrations of 300 and 500 ppb, as well as undertake a six point linearity test across the operating ranges of the NO_x, CO and SO₂ analysers.

These analyser tests must be undertaken every six months, at the scheduled service programme in accordance with the QA/QC guidelines issued on release of the QA/QC audit schedule. The service is carried out in following three stages:

- Pre-service analyser tests and calibration
- Equipment servicing
- Post-service analyser calibration and tests and call to CMCU with relevant details

At the majority of direct funded sites, sample manifolds have been removed and replaced with separate sample lines. At affiliate sites there may be a mixture of sample manifolds and separate sample lines. At sites where sample manifolds are still fitted, these must be completely dismantled and cleaned every six months. The manifold blower must also be dismantled, cleaned and lubricated. All PTFE lines which are exposed to ambient air, up to the first Sample Inlet Filter, are to be replaced annually and cleaned six months after replacement.

The ESU will service and maintain the Zero Air Generator (ZAG) pumps (where fitted), and replace the consumables in ZAG scrubbers every six months. Zero air cylinders (where these are used) will be supplied on the same basis as span gas cylinders. If requested by CMCU, the ESU will also be required to change the PTFE lines between the ZAG and the instruments and between the calibration gas cylinders and the instruments.

Annual vacuum pump re-builds must be undertaken with flows audited prior to, and after, through the use of a flow meter certified to BS EN ISO 17025: 2005 with the exception of FDMS pumps which must be rebuilt every 6 months. (The number of sites where the FDMS is still used is now very small). Where pumps cannot be refurbished they should be exchanged with a new pump on the day of the service.

Where a Fidas is at a site, the ESU should follow the procedures for service and maintenance as agreed with the manufacturer PALAS. A zero and calibration check with MonoDust shall be undertaken and advice sought if these fall outside manufacturer specifications. The ESU is to complete the following tasks on a 6 monthly basis

Flow and leak check

MonoDust calibration check

Removal and cleaning of the inlet trap, pump filter and the sample inlet head

Where a BAM is at a site the ESU is to complete the following tasks on a 6-monthly and annual basis.

As a minimum the ESU should complete the following during each 6-monthly service;

- Replace or clean the pump muffler (if used)
- Test Pump Capacity
- Test Filter RH and Filter Temperature sensors
- Test Smart Heater

- Clean Capstan Shaft and Pinch Roller Tyres

In addition the ESU should complete the following on an annual basis;

- Clean Internal Debris Filter
- Check Membrane Span Foil
- Beta Detector Count Rate and Dark Count Test
- Clean Inlet Tube
- Test Analogue DAC Output (if used)
- Replace Lithium battery if required
- Re-build Vacuum Pump
- Replace Nozzle O-ring (Special tools required)
- Replace Pump Tubing

All routine service visits are to be fully documented and completed in accordance with procedures described within the Local Site Operator's Manual (issued by the QA/QC Unit). With special emphasis on ensuring that all relevant instruments are out of service during ESU maintenance/service activities and must be returned to the correct sampling mode upon completion of works.

Routine service visits must be fully documented and describe in detail any adjustments modification or repairs undertaken. Results of the analyser tests performed during the service are recorded on the 'Analyser Performance Test' form provided, or with any other electronic or paper system which has previously been agreed with the QA/QC and CMCU /Management Units. All metadata relating to sites and analysers must be recorded. Any ESU forms/templates must be provided to CMCU and QA/QC in advance of contract commencement for approval. Any amendments to these forms/templates during the contract period must be reviewed and approved by both CMCU and QA/QC.

The service records, together with the pre- and post-service calibration sheets, are e-mailed to the CMCU / Management Unit and QA/QC Unit at the earliest opportunity and within seven days at the latest. Upon completion of the service any concerns with regards to the condition or age of equipment must be summarised along with recommendations for improvements, and presented to CMCU within two weeks of the completion of the service run.

1.1.2. Emergency Service and Maintenance

In the event of equipment malfunction between routine service visits, the appointed ESU will be required to carry out emergency repairs. The emergency call-out will be issued by the CMCU. During normal working hours (Mon-Fri, 0830-1730) emergency call-outs will be notified by telephone and confirmed by e-mail call out pro-forma.

It is a requirement that the ESU attends site and effects repairs within 48 hours of receiving notification from the CMCU. If the faulty equipment cannot be repaired at site within the required timescale, then a replacement hot-swap unit should be fitted within 72 Hours from the point at which the requirement for workshop repair is identified. Where a hot-swap instrument is to be installed the ESU must notify CMCU immediately confirming the instrument make/model and serial number and notified when the original instrument is repaired and returned to site.

All hot-swap instruments must be fully bench tested and satisfactory performance established prior to site installation. Upon installation and following the necessary

stabilisation period, hot-swap gaseous pollutant analysers shall be calibrated using the on-site standards and the results reported to CMCU and QA/QC.

Where instruments are returned to site for workshop repair, the units must be repaired and returned to site within 10 working days and updates provided to CMCU on the progress of repairs within five working days. Upon removal of a hot swap gaseous analyser, the ESU must carry out a calibration of the analysers prior to them being removed from site and report calibration values to CMCU.

Specific procedures related to emergency call-outs are detailed within the Site Operator's Manuals. The 48-hour response and hot-swap installation timescales are required for all working days of the year, excluding weekends and Public Holidays. In all cases the ESU must confirm to the CMCU that they have received the call-out, and that the required response is underway. On arrival at site the engineer must notify CMCU before carrying out the repair and on completion notify CMCU with relevant details and complete the site log where one is present.

As a general guide, the following circumstances may give rise to an emergency call-out - **this list is not exhaustive**:

- Electronic or pneumatic instability of the instruments
- Auto-calibration checks outside of acceptable tolerances
- Instruments operating outside of manufacturers specifications
- Manual calibration checks outside of acceptable tolerances
- Malfunctions identified with the sample manifold, data logging or gas calibration systems
- Malfunction of the air conditioning unit.
- Malfunction of the communication package (modem, code activate switch etc.)
- Investigations into the condition of a site following reported damage / vandalism
- Attendance to auto-calibration functionality including where permeation tube exchange
- Effecting simple roof repairs (replacement roof glands and or expanding foam)

Whilst these criteria provide guidance on call-out procedures, emergency call-outs will be issued at the **sole discretion** of the CMCU. ESU's should note that a calibrated ozone photometer and/or NOx converter test equipment may be required during an emergency call out visit for ozone or NOx analysers respectively.

All emergency call-out visits must be fully documented and reports must describe all equipment malfunctions, repairs or replacements. In the event that instrument adjustments are necessary which affect its response, these must be agreed in advance with the CMCU, and **must** be accompanied by the relevant Pre (as found) and Post-Calibration Checklists and Calibration Records. Documentation must be e-mailed to both CMCU and the QA/QC Unit as soon as possible, and within seven days at latest.

It is the responsibility of the ESU to ensure that, where fitted, the daily overnight auto calibration system (autocal) are functional and any call outs relating to the autocal must be attended to within the 48 hour response time.

1.1.3. Supply of Consumables

The ESU will be required to provide and maintain adequate consumable supplies to cover the period starting (start date of the contract) onwards for the full term of the contract.

Additional supplies of consumables may be requested at the discretion of CMCU should supplies be exhausted ahead of the anticipated supply period. In such cases consumables

are to be despatched to the relevant site LSO within five working days of notification by CMCU. Should consumables be lost or damaged in transit the ESU will be expected to replace these without charge.

CMCU will monitor the use of consumables and will request justifications from LSOs when stocks are exhausted prior to the date when they are due to be replenished.

The ESU will not be expected to supply filters for gravimetric samplers (PM₁₀ or PM_{2.5}) at the small number of sites which have these or calibration gases. Any consumable sent to or left at sites (especially any cleaning agents) must be in clearly marked containers stating '**For AURN use only**' and state on the box the anticipated duration the supply is expected to last (i.e. 12 months).

Provision of Permeation Tubes is to include the installation of Permeation Tubes at site as and when requested by CMCU. The ESU will issue sufficient consumables from 1st October to last either a **6-month or 12-month** period and replenish stock **one month** before each batch is nearing exhaustion. The consumables provided for use on the AURN **must** be kept at site and only used on AURN equipment exclusively.

For FDMS (where still used) all "wetted" parts of the sampling system from the inlet to the detector must be manufacturer or QA/QC approved.

BAM tapes for use on the networks are currently Sibata, however a supply of Whatman tapes are being evaluated across the network. Please contact your CMCU if you intend to order a new tape supply to confirm the latest preferred tape type.

1.1.4. Air Conditioning Units

Many of the Environment Agency-owned monitoring stations are equipped with air conditioning units. Instruments can be extremely sensitive to temperature fluctuations and as such maintaining a stable cabin temperature is essential. Poorly maintained air conditioning (A/C) units can lead to significant data loss and it is the ESUs responsibility to ensure that A/C units are serviced and maintained in accordance with manufacturers recommendations. Both routine (6-monthly) servicing and emergency call-out should be provided for and must be included, where applicable. It is essential that where issues with A/C units are identified as performing poorly that an ESU attends site to investigate the cause of the fault within 48 hours after receiving notification from the CMCU. The 48-hour response timescale is for all working days of the year, excluding weekends and Public Holidays. The mechanism of servicing Air Conditioning units is the responsibility of the site owners at affiliated sites and this may be through inclusion in their ESU contracts.

Where a fault is identified, that cannot be rectified by the ESU on site, CMCU **must** be provided with an evaluation of the fault and recommendation for repair/replacement within 24 hours. CMCU may request a quotation for the replacement of the unit and from the point of request the ESU must assist with providing a quotation within **three working days** which includes an estimated time for the repair to be affected.

1.1.5. Spares and Calibration Equipment

Where ESUs support direct funded equipment (Environment Agency owned assets) a number of Hot-swap instruments will be made available to the ESUs, with the exception of gravimetric PM samplers.

The contractors will be issued with a minimum of one of each of the following instruments for collection from Environment Agency stock and storage at their premises.

- PM (Met One BAM, Fidas 200),

- NO_x (API or Thermo)
- SO₂, (API, Thermo or Serinus)
- O₃ (API or Thermo)
- CO (API or Thermo)

Upon receipt of an ESU's allocation of hot-swap instruments, instruments should be serviced and bench tested to confirm the health of the units provided. Where required the ESU is permitted, within the first two months of the contract, to contact CMCU to seek assistance for the repair of any major pre-existing faults with the instruments provided. ESUs are expected to cover any minor repairs or servicing required. Where repairs are required to rectify any major pre-existing faults a case for either financial assistance or provision of a replacement hot-swap instrument will be considered.

When stored at the ESU's premises the hot-swap instruments must only be used for AURN purposes, must not be used for spares and must be maintained such that they remain serviceable and ready for immediate deployment. The ESU should include provision for future repairs / servicing of the hot swap instruments through the full contract period. At the end of the contract the instruments must be bench tested and returned to the EA in full working order.

Immediately before any repair, adjustment, or replacement of an analyser, it is **essential** that the instrument is calibrated (if possible) in an 'as found' state using the on-site calibration gases. In the case of ozone analysers, this calibration must be completed against a reference photometer.

Photometers are required for use within the AURN and must be provided by the ESU. Each photometer is required to be calibrated against a reference standard photometer. All ESUs are required to attend a calibration exercise at QA/QCs premises twice each year for this purpose. The calibration of a maximum of three photometers per ESU will be carried out free of charge. Any additional photometers that require testing beyond this will be charged at £300 per photometer.

If a photometer is not working or the ESU providing the photometer does not know how to work the unit when being brought to test, the ESU will be charged for a re-test.

1.1.6. Parts Supply and Stock

Availability of parts for instrumentation can have a significant impact on the operation of the network and ability to achieve high data capture. The ESU must hold sufficient stock of all component parts required for the operation of the network and for all makes and models of instruments and models for which they are awarded responsibility.

For PM instruments all "wetted" parts of the sampling system from the inlet to the detector must be manufacturer or QA/QC approved.

The ESU will be wholly responsible for ensuring that they hold the correct level of stock sufficient to prevent any data loss as a result of parts being unavailable. It is the expectation that all spare parts required for repairs on the instruments they are responsible for are to be provided by the ESU.

The ESUs will also be responsible for any sample lines, critical orifices and calibration systems, where applicable, relating to the instrumentation they are responsible for. Cover should also be included for all PTFE tubing and/or critical orifices to both the instruments, sample inlet and calibration cylinders.

The ESU is also expected to cover the like for like replacement of any standard communication equipment such as modems and Code Activated Switches (CAS). The

purchase of replacement temperature and pressure sensors would be covered by CMCU on an ad-hoc basis, however ESUs would be expected to cover the installation of the sensors as part of a call-out or at the next site visit at CMCU's discretion.

Where any difficulties which are foreseen or arise with regards to the availability of manufacturer supplies of parts, for example parts no longer being manufactured, the ESU must notify CMCU immediately via an Exception Report e-mailed to CMCU's Project Manager and Project Director. The report would be a short e-mail summarising; the instruments affected, the cause of the issues identified, risks to service provision and any recommendations.

1.1.7. ESU Meetings

Provision should be made for the ESU to attend at a minimum of two ESU meetings per year hosted by the CMCU. The meeting would be to discuss ESU performance against KPIs and any current operational matters and contractors should allow for a full days attendance. A minimum of one senior engineer must attend the meeting and at least one member of QA/QC will be present. CMCU may also request that the ESU attends additional meetings where there are concerns with regards to performance and/or if any significant changes to network operation require ESU attention such as the introduction of new instrumentation. The ESU will also be requested to attend short conference calls relating to works associated with network expansion or reconfiguration. Such meetings will typically be between 30-60 minutes.

1.1.8. Site Details and UK-AIR

Defra's online air information resource (UK-AIR at (<http://uk-air.defra.gov.uk/networks/search-site-info>) lists information on each site, including details of the local environment, the position of the station on an interactive map, and photographs indicating a 360 degree view around the site. ESUs are required to advise the CMCU if significant changes have taken place in the environs of the site, so that the information on UK-AIR can be updated.

1.1.9. Health and Safety Responsibilities

CMCU has responsibilities for the Health, Safety and welfare of people working at Defra-owned Air Quality Monitoring Stations. This is particularly the case where contractors are appointed directly to CMCU. Health and Safety law requires that the risks associated with working in a potentially hazardous environment are identified and assessed, and that working conditions and practices employed are safe. Where necessary, Safe Systems of Work are required to be implemented.

Individuals working at or visiting an EA-owned AQMS also have legal responsibilities to co-operate with CMCU's and QA/QCs Health and Safety co-ordinators efforts to improve health and safety and not to undertake unsafe working practices. The responsibilities of an ESU are listed in the "UK Air Quality Monitoring Networks Health and Safety Guidance" document:

The guidance on risk assessments and health and safety legislation is just a summary of the risks that are involved and third parties are responsible for ensuring they meet UK Health and Safety legislation.

The Health and Safety Guidance document provides guidance for Environment Agency contractors on a wide range of health and safety responsibilities which are relevant to

ESU's working at air quality monitoring sites. They need to familiarise themselves with this document prior to appointing ESU services. A link to the guide is [here](#)

The Health & Safety Database has been developed to allow ESUs (Equipment Support Units), LSOs (Local Site Operators), network managers, site owners and EA access to upload and download selected safety information. The database is available to the stakeholders in all EA national air quality networks, and can be accessed at <https://hnsdb.defra.gov.uk> If you do not already have a username and password please contact a member of the CMCU team for these details.

1.1.10. Fire Extinguisher Provisions

CO₂ fire extinguishers are provided at direct funded sites (with the exception of rural remote locations). Annual testing and replacement of fire extinguisher units is coordinated by CMCU and tests are carried out at the EA store located in Stroud, Gloucestershire. ESUs will be expected to support the exchange programme on an annual basis as part of summer services by assisting with the installation of newly serviced fire extinguishers and collection and return of fire extinguishers which have expired their 12-month service period. All costs to ship extinguishers to and from regional engineers should be included.

1.1.11. First Aid Kits

First Aid Kits are to be provided along with consumables and replaced on or before their expiration date. First aid kit contents must comply with BS 8599 and matches or exceed the requirements of the sites risk assessment. A minimum stock of first-aid items would be:

- a leaflet giving general guidance on first aid
- individually wrapped sterile plasters (assorted sizes), appropriate to the type of work;
- sterile eye pads;
- individually wrapped triangular bandages, preferably sterile;
- safety pins;
- large sterile individually wrapped un-medicated wound dressings;
- medium-sized sterile individually wrapped un-medicated wound dressings;
- disposable gloves

1.1.12. Ladders

ESUs are responsible for carrying out a visual inspection of ladders every time a ladder is used at site at every 6 monthly service using the Ladder Pre-use Inspection Checklist provided by CMCU.

Where faults with ladders are identified they are to be reported to CMCU immediately. Upon notification CMCU may request that they assist with removal of ladders from site or labelling of ladders as faulty.

1.1.13. Portable Appliance Testing (PAT)

At the time of the first site service, and thereafter on an **annual basis**, PAT testing of all analysers and associated peripherals shall be undertaken. The testing equipment used must be capable of storage and download of full test results for reference including production of a test certificate when requested. All equipment removed from site for investigation or repair, including temporary replacement analysers, must be inspected and

tested before installation. Each piece of mains operated equipment must have appropriate test labels attached indicating when the testing was last completed and when it is due for re-testing. Test equipment such as the appliance tester must be calibrated annually by the manufacturer or other qualified institution to ensure it is within specification. Testing is to be completed in accordance with the IET (Institution of Engineering and Technology) Code of Practice for In-service inspection and testing of electrical equipment (4th Edition).

1.1.14. Periodic Inspection Report

An Electrical Installation Condition Report (EICR) for Inspection and Testing of the fixed electrical installation at each site is required every 3 years for direct funded sites. This testing must be carried out by a suitably qualified electrician who is participating in a competent person scheme such as the NICEIC or equivalent which relates to the type of installation being tested. A Certificate must be issued and provided to CMCU in PDF format and a copy left at each site on display for future reference.

Appendix B – Safety Data Sheets for Gases

BOC, the current Gas Supply contractor for the AURN, has provided Safety Data Sheets for each type of gas supplied to the Networks. BOC Safety Data Sheets are available on the 'Operations' page of the AURN Hub, and can be accessed by clicking on the relevant link in the list below.

1.2. BOC Gas Safety Datasheets

- [NO 450 ppb](#)
- [NO₂ 450 ppb](#)
- [SO₂ 450 ppb](#)
- [CO 35 ppm](#)
- [CO 20 ppm](#)
- [Zero Air](#)

Gas cylinders provided by the previous contractor, Air Liquide UK, are still in use at some AURN monitoring stations. Safety Data Sheets for Air Liquide gases can be accessed by clicking on the relevant link in the list below.

1.3. Air Liquide Gas Safety Datasheets

- [NO < 1 ppm](#)
- [NO₂ < 1 ppm](#)
- [SO₂ < 1 ppm](#)
- [CO < 1000 ppm](#)

These Safety Data Sheets are also available via the 'Operations' page of the AURN Hub.

Appendix C - Gas Regulator Returns Procedure

This procedure describes the steps required in order to organise the replacement or repair of a gas regulator.

1.4. Broken or Faulty Regulator.

1. Contact the appropriate member of the Ambient Air Monitoring (AAM) team at the Environment Agency by email (details below) in order of listing. Please request an EA regulator repair.
2. If an “out of office” automated reply is received, then please progress to the next contact. In all instances please also copy in the email below:
 - AAMTEAM@environment-agency.gov.uk

If you have had no reply within 48 hours, please escalate to the team leader by telephone.

3. Confirm your contact details and the AURN site (using its official name). Please also state the following details regarding the regulator:
 - Details of the type of gas cylinder the regulator is connected to (NO/ SO₂/CO/Zero Air)
 - The unique regulator I.D. number, usually starts with the prefix “DEF”.
 - Description of the fault. (e.g. broken gauge, connection wont seal, unstable pressure, etc)
 - Address for replacement regulators to be couriered to.
4. You will receive a reply within five working days stating the AAM team’s intentions, and a unique reference number. Included will be an attachment containing a returns address and unique reference number.
5. If it is decided that a replacement regulator is required, it will be sent out by the AAM team to the address supplied by yourselves, or if absent, the registered address on the LSO contact details spreadsheet.
6. Once you receive the replacement regulator, you will find inside a prepaid returns postage label. Please reuse the box and packaging you received the regulator in and attach the prepaid postage label. You can take this to any convenient post office. If the box is badly damaged or unusable then please contact us for a replacement box to be sent out, or find other suitable packaging of your own.
7. Please ensure prompt return of the faulty/damaged regulator so it can be assessed and possibly refurbished, ready to be reused on the AURN.

1.5. Return of Regulator Reaching End of Life (EOL).

1. Any regulator reaching five years old should be returned to the AAM team for refurbishment, or replacement. There is no need for the LSO to do anything initially as the AAM team will contact the appropriate LSO when this time is approaching.
2. The AAM team will contact the LSO by email and include a unique reference number. Please reply within five working days stating any alternative arrangements you’d like regarding the address for postage of the new regulator. If no contact is made, or unfeasible request made, then it will be despatched to the contact details held on the LSO contact spreadsheet.

3. We will state which calibration gas the regulator is intended for and include a prepaid postage label for returning the EOL regulator.
4. Please swap out the regulator at the next LSO visit, and promptly return the EOL regulator. Please reuse the packaging that your replacement regulator arrives in. Attach the prepaid postage label and you can take this to any convenient post office. If the box is badly damaged or unusable then please contact us for a replacement box to be sent out, or find other suitable packaging of your own.
5. If you think you have some regulators beyond five years old, please contact the AAM team.

1.6. Contacts

In order of preference:

| Contact Name | Telephone Number | Email |
|---|------------------|--|
| Robert Molyneux | 07881 833205 | Bob.Molyneux@environment-agency.gov.uk |
| Ben Fisher | 07979 630428 | Ben.fisher@environment-agency.gov.uk |
| Matthew Shutt (Team Leader) | 07770 880894 | Matthew.shutt@environment-agency.gov.uk |
| In all cases please also copy in the address: AAMTEAM@environment-agency.gov.uk | | |

Appendix D – Gas Regulators

Each gas cylinder at Automatic Urban and Rural Network (AURN) and Automatic London Network (ALN) monitoring stations is fitted with a regulator to control the pressure and flow of gas to the analyser during routine calibrations. There are two types of regulator currently in use. It is important that gas is delivered to the analyser at atmospheric pressure, with sufficient flowrate to supply the analyser at its operational sample flowrate.

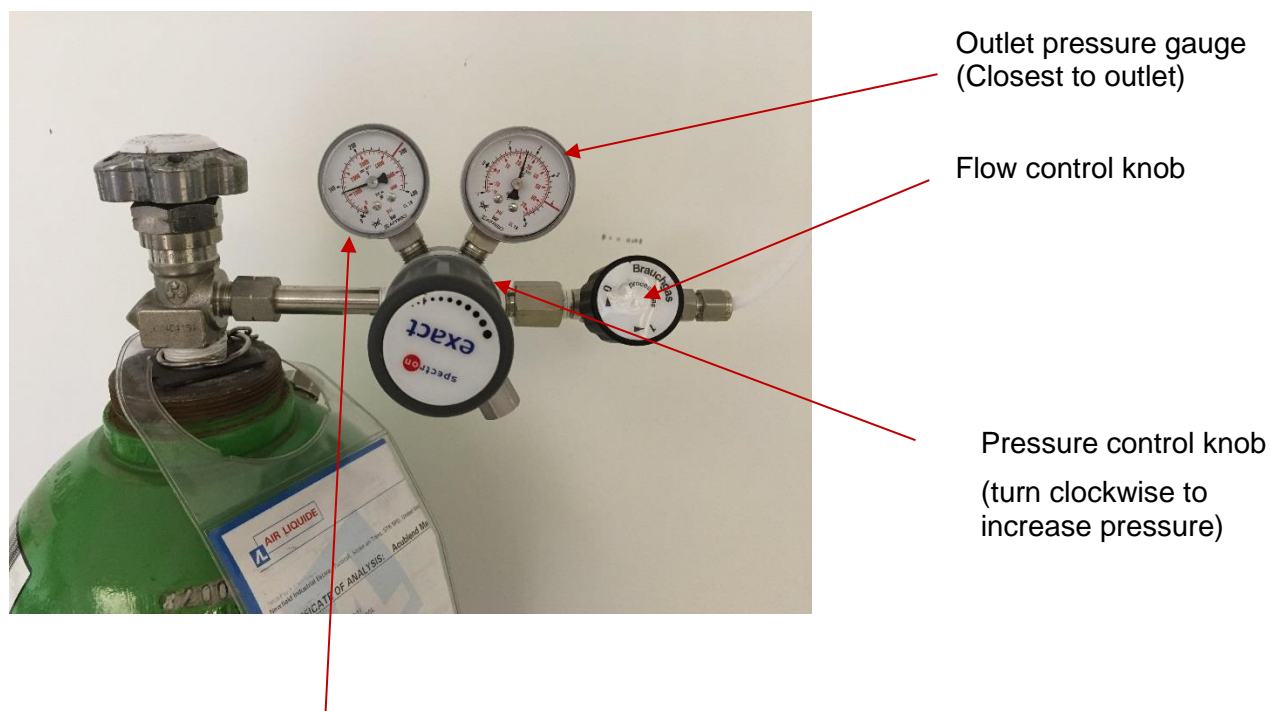
Regulators must have the correct valve fitting for the gas they are intended for:

- BS14 Right handed thread (internal thread on regulator) for nitric oxide (NO) and sulphur dioxide (SO₂) mixtures
- BS15 Left handed thread (internal thread on regulator) for monthly calibration carbon monoxide (CO) mixtures
- BS3 Right handed thread (external thread on regulator) for zero air
- BS4 Left hand thread (external thread on regulator) for daily CO autocalibration cylinders

Regulators for NO and SO₂ are made of stainless steel, and for CO and air are normally brass. BS14 and BS15 regulators have a Teflon (PTFE) washer inside the nut to provide a seal against the cylinder valve.

1.7. Conventional Pressure Regulator

This type of regulator has a controlled pressure output, and a secondary valve is used to control the flowrate. This type of regulator has two pressure gauges; one shows the pressure in the cylinder upstream of the regulator, and the second one shows the outlet pressure. The second pressure gauge should be set at 2-3 bar depending on the configuration of the site. This regulator is required where the flowrate delivered to the analyser is controlled by a flow restrictor (critical orifice) in line.



Cylinder pressure gauge (Closest to cylinder)

1.8. Selectable Flow Regulator



Flow control knob
(litres per minute)

Cylinder pressure gauge

A selectable flow regulator allows control of the flowrate directly. A dial on the end of the regulator allows selection of the desired flowrate. This should normally be 1 to 1.5 litres per minute which is adequate for all analysers in the AURN. This allows for a small excess of gas flow, which is vented through the sample inlet tube during calibration.

At any AURN monitoring station, the regulators should either be all of the conventional type, or all of the selectable flow type. There should not be a mixture of the two: if you think there may be, please contact the CMCU / Management Unit.

1.9. Changing a Regulator

When an empty cylinder is replaced with a full one, the Local Site Operator (LSO) will need to remove the gas pressure regulator from the empty cylinder and replace it on the new cylinder. Although this is a simple procedure, training is necessary to ensure it is carried out safely. This training will be provided by the QA/QC unit where required. Always wear safety glasses when changing cylinders and regulators, and protective footwear when moving cylinders. The procedure is as follows:

- Ensure cylinder valve is fully turned off;
- Depressurise the regulator by operating the purge valve on the system. The regulator will not unscrew safely when still under pressure;
- Unscrew the regulator using the spanner supplied. Note that BS4 and BS15 (all CO cylinders) are left hand threads i.e. are unscrewed clockwise. Left handed fittings are distinguished by notches cut in the fitting nut;
- Connect the regulator to the new cylinder, ensuring that the sealing washer is intact. Take care not to cross-thread the regulator on the cylinder valve. When tightening the regulator, apply moderate force only; do not over-tighten.
- Close the regulator outlet valve (small knob) or turn the flow knob to zero. Gently open the cylinder valve; the inlet pressure gauge should rise. Turn the cylinder valve off and check the regulator fitting for leaks, using a leak detection fluid such as "Snoop™" fluid if necessary.
- Purge the air from the regulator by allowing gas from the cylinder to flush out all air in the regulator and line through the purge valve - repeat twice. Air in the system may give false readings and cause the nitric oxide (NO) calibration gas to become unstable.

- If the system is on non-continuous operation, pressurise the regulator and close the cylinder valve. The regulator should be left in this pressurised state to ensure there is no ingress of ambient air. If the system is on continuous operation (i.e. for daily autocalibrations), leave the cylinder valve open, with the system under pressure.

This completes the regulator changing procedure. Please print out these notes and display them inside the monitoring station, where they can be read by anyone who may need to change a cylinder or regulator.

If you have any questions, please contact the QA/QC Unit on AQadmin@ricardo.com for non-ALN sites, [AURN ALN Calibration@npl.co.uk](mailto:AURN_ALN_Calibration@npl.co.uk) for ALN sites.

Appendix E – Glossary of Abbreviations and Conversion Factors

| | |
|---|---|
| AURN | Automatic Urban and Rural Network |
| ALN | Automatic London Network |
| BAM | Beta Attenuation Monitor |
| CMCU | Central Management and Co-ordination Unit |
| CO | Carbon Monoxide |
| DA's | Devolved Administrations - Scottish Government, Welsh Government and Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland |
| Defra | Department for Environment, Food and Rural Affairs |
| ERG | Environmental Research Group (of Imperial) |
| ESU | Equipment Support Unit |
| EU | European Union |
| FDMS | Filter Dynamics Measurement System |
| IR | Infra-red |
| LA | Local Authority |
| LAQN | London Air Quality Network |
| LSO | Local Site Operator |
| mg m ⁻³ or mg/m ³ | milligrams per cubic metre |
| MU | Management Unit |
| nm | nanometres |
| NO | Nitric Oxide |
| NO ₂ | Nitrogen Dioxide |
| NO _x | Oxides of Nitrogen (NO + NO ₂) |
| NPL | National Physical Laboratory |
| ppb | parts per billion |
| ppm | parts per million |
| PM ₁₀ Particulate Matter | the mass fraction of particles collected by a sampler with a 50% inlet cut-off at aerodynamic diameter 10µm |
| PM _{2.5} Particulate Matter | the mass fraction of particles collected by a sampler with a 50% inlet cut-off at aerodynamic diameter 2.5µm |

| | |
|---|--|
| QA/QC | Quality Assurance and Control |
| SO ₂ | Sulphur Dioxide |
| TEOM | Tapered Element Oscillating Microbalance |
| UKAS | United Kingdom Accreditation Service |
| UV | Ultra-violet |
| µm | Micrometres |
| µg m ⁻³ or µg/m ³ | micrograms per cubic metre |

1.10. Conversion Factors – (at 293K and 101.3 kPa)

| | |
|---|--|
| Nitric Oxide | 1 ppb = 1.25 µg/m ³ 1 µg/m ³ = 0.8 ppb |
| Nitrogen Dioxide | 1 ppb = 1.91 µg/m ³ 1 µg/m ³ = 0.523 ppb |
| Total Oxides of Nitrogen (NO _x) | NO _x in µg/m ³ is expressed as NO ₂ i.e. (NOppb + NO ₂ ppb) x 1.91 = NO _x µg/m ³ |
| Sulphur Dioxide | 1 ppb = 2.66 µg/m ³ 1 µg/m ³ = 0.38 ppb |
| Ozone | 1 ppb = 2.0 µg/m ³ 1 µg/m ³ = 0.5 ppb |
| Carbon Monoxide | 1 ppm = 1.16 mg/m ³ 1 mg/m ³ = 0.86 ppm |

Appendix F – Partisol Checklist and Record Sheet

1.11. Partisol 2025 Equipment Update:

1.11.1. Gravimetric Sampling of PM₁₀ and PM_{2.5}

The table below provides the current status of the operation of Partisol 2025 gravimetric sampler for PM₁₀ and PM_{2.5}. (As of January 2021, there are only two in the AURN, both at London Marylebone Road.) Please fill out the form at each fortnightly site visit and return to Bureau Veritas immediately after the site visit along with a copy of the Filter ID sheet of the filters you are returning to the laboratory at: Unit 2/8 Langlands Place, Kelvin South Business Park, East Kilbride, G75 0YF

CONTACT(s): **David Harrison** **E-mail: david.harrison@bureauveritas.com**

Where an instrument is not running accordingly, please add any additional comments in the box below.

| | | |
|--------------|----------------------------------|----------------------------------|
| Operator(s): | Inlet Cleaned? | Successful filter exchange? |
| _____ | (Y/N) [PM _{2.5}] _____ | (Y/N) [PM _{2.5}] _____ |
| _____ | (Y/N) [PM ₁₀] _____ | (Y/N) [PM ₁₀] _____ |

| Site No. | Size | Site Name | Date/ time of Filter Exchange | Date of Dispatch to Lab | Instrument Status i.e. Running? (Y/N) | ID of last Filter to have been exposed | ID of next Filter to be exposed |
|----------|-------------------|-----------|-------------------------------|-------------------------|---------------------------------------|--|---------------------------------|
| | PM _{2.5} | | | | | | |
| | PM ₁₀ | | | | | | |

| | Current Filter ID | Filter IDs of any unexposed cartridges |
|-------------------|-------------------|--|
| PM _{2.5} | | |
| PM ₁₀ | | |

Commentary:

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