AEAT/R/ENV/0656 - Issue 1

Intercalibration Report for the Automatic Urban Network, March 2001

Brian Stacey

May 2001

AEAT/R/ENV/0656 - Issue 1

Intercalibration Report for the Automatic Urban Network, March 2001

Brian Stacey

May 2001

Title	Intercalibration Report for the Automatic Urban Network, March 2001
Customer	Department of the Environment, Transport and the Regions, The Scottish Executive, The National Assembly for Wales and Department of the Environment in Northern Ireland
Customer reference	
Confidentiality, copyright and reproduction	Unrestricted. Copyright AEA Technology plc All rights reserved. Enquiries about copyright and reproduction should be addressed to the Commercial Manager, AEA Technology plc.
File reference	EEQP 20568104
Report number	
Report status	AEAT/R/ENV/0656 - Issue 1

Brian Stacey
AEA Technology Environment
Culham Science Centre
Abingdon
Oxfordshire
OX14 3ED
Telephone 01235 463177
Facsimile 01235 463011

	Name	Signature	Date
Author	Brian Stacey		
Reviewed by	Jane Vallance-Plews		
Approved by	Ken Stevenson		

Executive Summary

In January to March 2001, NETCEN conducted an intercalibration exercise of 70 sites in the Automatic Urban Network. The tests were undertaken to cross-reference the individual data sets to common traceable calibration standards. This enabled the consistency of measurements throughout the network to be determined.

The results of the intercalibration are summarised in the table below:

Parameter	Number of outliers	Number in network	% outliers in total
Ozone analyser	25	46	54%
NOx analyser	28	66	43%
CO analyser	8	57	14%
SO_2 analyser	6	57	11%
TEOM analyser	2	47	4%
Total	69	273	25%

An outlier is defined as an analyser that shows a deviation from the network mean of greater than 10% for NOx, CO and SO_2, 5% for O_3 and a k_0 deviation of more than 2.5% for TEOM.

In addition, 20 of the 241 site cylinders (8%) appeared to have drifted by more than 10% from their certificated values. Three NOx converters were found to be outside the 95% acceptance limit.

The number of analyser outliers identified has increased at this audit, compared to previous exercises. At the summer intercalibration, 19% of the analysers in use were identified as outliers.

The performance of the network analysers is graded in terms of how their performance could impact on data quality. This process has again highlighted that the majority of outliers are very minor in nature and are only likely to have minimal consequences for data capture or data quality.

The performance of 37 of the 55 Local Site Operators was also assessed during this exercise. All the LSO's that were assessed remain keen, and continue to perform their tasks to a consistently high standard.

During this intercalibration, the following new procedures have been introduced:

1. The regulators that are deployed on site are also used to calibrate with audit gases. This procedure minimises the risk of compromising results, due to the possibility of contaminated audit regulators.
2. LSO's are provided with a "feedback form", to inform them of the perfomance of their analysers. This is especially useful for affiliated sites, where the LSO's are responsible for actioning any call-outs for repairs.
3. The results from previous intercalibrations are now accessed electronically, to identify any "repeat offenders". This time saving enhancement allows ready identification of any long

term trends in poor analyser performance, to allow action plans to be devised (eg analyser replacement, converter tests, cylinder replacement etc)

Appended to this report is the UKAS Certificate of Calibration. The certificate presents the results of the individual analyser calibration factors on the day of the audit visit, as calculated by NETCEN using the audit transfer standards, in accordance with our UKAS accreditation to ISO 17025.

In summary, the network continues to operate at a high standard, providing data that are accurate, consistent and traceable to national metrology standards. This report presents the findings from the intercalibration exercise, listing outliers and identifying causes for any poor performance.

Contents

1 Introduction

AEA Technology's National Environmental Technology Centre (NETCEN) has undertaken an intercalibration of air quality monitoring sites in the Automatic Urban Network (AUN) in January to March 2001. These intercalibrations are used to complete a wide range of tests to evaluate the performance of each monitoring station. The following major checks are made:

1. **Analyser accuracy and precision**, as a basic check to ensure reliable datasets from the analysers.
2. **Instrument linearity**, to check that doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser is not linear, data cannot be reliably scaled into concentrations.
3. **Instrument signal noise**, to check for a stable analyser response to calibration gases.
4. **Analyser response time**, to check that the analyser responds quickly to a change in gas concentrations.
5. **Leak and flow checks**, to ensure that ambient air reaches the analysers, without being compromised in any way.
6. **NOx analyser converter efficiency**, to ensure reliable operation. This is the device that allows the publication of NO_2 datasets, so it must work acceptably.
7. **TEOM k_o evaluation**. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine it's accuracy.
8. **SO_2 analyser hydrocarbon interference**, as certain hydrocarbons are known to interfere with the SO_2 detector.
9. **Evaluation of site cylinder concentrations**, using a set of NPL certified cylinders that NETCEN take to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentration of gas in the cylinder does not change.
10. **Competence of Local Site Operators** (LSO) in undertaking calibrations. Similarly, as it is the calibrations by the LSO's that is used to scale pollution datasets, it is important to check that the calibrations are undertaken competently.

In addition to the above tests, a "Network Intercomparison" is conducted. This exercise relies upon the fact that NETCEN carry a set of cylinders (called "audit gas") to all the sites in the AUN. These cylinders have been recently calibrated by NPL, and allow us to examine how different site analysers respond when they are supplied with the same gas used at other sites.

The technique used to process the intercomparison results is broadly as follows:

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained on the day of the intercalibration. This factor is also used for sending out provisional data to the web/teletext/Met Office.
- These individual results are tabulated, and statistical analyses undertaken (eg network average result, network standard deviation, deviation of individual sites from the network mean etc.)

These results are then used to pick out problem sites, or "outliers", which are then investigated further to determine reasons and investigate possible remedies for the outliers. The definition of an outlier is a site result that falls outside the following limits:

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated k_0 value for TEOM analysers,
- ±10% for particulate analyser flow rates.

As stated, any outliers that are identified are rigorously checked to determine the cause, and corrective action taken, if necessary. Further details of the typical causes can be found in Section 2.

The procedures used to determine network performance are documented in AEA Technology Work Instructions. These methods are regularly updated and improved and have been evaluated by the United Kingdom Accreditation Service (UKAS). NETCEN holds UKAS accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3 and PM_{10}) used in the AUN. A UKAS Certificate of Calibration (Calibration Laboratory number 0401) for the urban sites in the AUN is appended to the report.

A total of 70 sites were audited in this exercise; sites at Blackpool and Southend-on-Sea commenced operation during the previous six months, and the site at Sunderland was reinstalled following building refurbishment.

This report presents the results for each pollutant, identifies analysers that did not meet performance standards, investigates the possible causes of these results and recommends any remedial action required to modify the datasets.

2 Analyser Performance

As with the Summer 2000 intercalibration report, individual analyser performance has been graded, to provide an indication of how data quality may be affected by the intercalibration results.

The performance grades are as follows:

1. **A** This grade is indicative of an analyser performing very well. All of the tests undertaken were within the required limits, and the quality of the ratified dataset produced by this instrument should be of a high standard. No data should be lost.
2. **B** This grade is indicative of an analyser performing well. The results of the tests have highlighted a minor outlier (for example as a result of minor drift in calibration factor, or a result slightly outside acceptance criteria). This type of outlier is not likely to be easily detected by the Local Site Operator or the CMCU. The quality of the ratified dataset produced by this analyser should be of a high standard. No data should be lost.
3. **C** This grade indicates an analyser performing acceptably. The results of the tests have highlighted a significant outlier (for example as a result of severe drift in calibration factor, or a result significantly outside acceptance criteria). Close examination of the performance history of the analyser may show that data could be retained, but may

require substantial adjustments to the dataset to be performed. It is possible that this type of outlier could be detected by the LSO or CMCU during the scheduled calibrations, but it is likely that the fault will remain undetected until the network intercalibration visit. The LSO should compare the current results with those from previous visits, and carefully examine the progress of the current analyser calibration, to ensure "expected normal" behaviour. Any deviations from these patterns should be reported to CMCU immediately. The quality of the ratified dataset produced by this analyser should be of an acceptable standard. It is possible that some data could be rejected during the ratification process.

4. **D** This grade indicates a poorly performing analyser. The results of the tests have highlighted a serious fault or outlier (for example, a poor NOx converter result, or significant losses of calibration gas to the sampling system), which will have serious implications for the quality of the instrument dataset. Again, the LSO and CMCU might be able to detect this type of poorly performing analyser during the scheduled calibration visits, but it is possible that the fault remains undetected until the network intercalibration visit. The LSO should report any "abnormal" behaviour to the CMCU immediately, who will then decide whether any remedial action is required. Depending upon the cause of the outlier, it is possible that much of the dataset will be salvageable during ratification, but it is likely that significant portions of data will be rejected as a result.

5. **E** This grade indicates either a very poorly performing analyser, or that the analyser was not available for testing. The results of the tests have highlighted a very serious fault, or the analyser has completely malfunctioned during the course of the tests, preventing any meaningful results being obtained. Data from this type of analyser will be seriously compromised, and it will be clear to both the LSO and CMCU that there is a fault with the equipment. Depending upon the exact nature of the fault, it may be possible to save data from the analyser, but it is most likely that large portions of the dataset will need to be rejected.

To further aid the readability of the report, the grades are colour coded: GREEN for grade A and B analysers, YELLOW for grade C and D analysers, and RED for grade E analysers. The Table below presents a summary of the network intercalibration:

Date visited	Site	NOx	CO	SO_2	O_3	PM_{10}
Sites in Scotland						
01/02/01	Aberdeen	**B**	**A**	**A**	**-**	**A**
31/01/01	Edinburgh Centre	**A**	**A**	**A**	**B**	**A**
30/01/01	Glasgow Centre	**A**	**B**	**A**	**A**	**A**
30/01/01	Glasgow City Chambers	**A**	**A**	**-**	**-**	**-**
29/01/01	Glasgow Kerbside	**C**	**A**	**-**	**-**	**A**
Sites in Wales						
26/02/01	Cardiff Centre	**A**	**A**	**A**	**A**	**A**
27/02/01	Port Talbot	**A**	**-**	**A**	**B**	**A**
27/02/01	Swansea	**A**	**A**	**A**	**A**	**A**
Sites in Northern Ireland						
23/01/01	Belfast Centre*	**-**	**-**	**-**	**-**	**-**
23/01/01	Belfast Clara St	**-**	**-**	**-**	**-**	**C**

Date visited	Site	NOx	CO	SO_2	O_3	PM_{10}
23/01/01	Belfast East	-	-	A	-	-
24/01/01	Derry	B	A	A	C	A
	Sites in England					
14/02/01	Barnsley 12	-	-	A	-	-
14/02/01	Barnsley Gawber	A	-	A	B	-
13/03/01	Bath Roadside	A	A	-	-	-
06/02/01	Billingham	B	-	-	-	-
26/02/01	Birmingham Centre	B	C	A	C	A
09/02/01	Birmingham East	A	A	A	B	A
29/01/01	Blackpool	D	A	A	C	A
24/01/01	Bolton	A	A	A	A	A
15/02/01	Bradford Centre	B	B	A	B	A
08/02/01	Brighton Roadside	C	A	-	-	-
16/01/01	Bristol Centre	B	B	A	B	A
15/01/01	Bristol Old Market	A	A	-	-	-
23/01/01	Bury Roadside	B	A	E	C	A
16/01/01	Cambridge Roadside	A	-	-	-	-
21/02/01	Coventry Centre	A	A	A	A	B
17/01/01	Exeter Roadside	A	A	A	B	-
08/02/01	Hove Roadside	A	A	B	-	-
22/02/01	Hull Centre	A	A	A	B	A
19/01/01	Leamington Spa	B	A	A	A	A
16/02/01	Leeds Centre	A	A	A	A	A
19/02/01	Leicester Centre	B	A	A	B	A
20/02/01	Liverpool Centre	A	A	A	B	A
09/01/01	London A3 Roadside	D	A	-	-	A
11/01/01	London Bexley	B	A	A	A	A
10/01/01	London Bloomsbury	A	B	A	B	A
15/01/01	London Brent	B	A	B	B	A
07/02/01	London Cromwell Road 2	A	A	A	-	-
10/01/01	London Hillingdon	B	A	A	A	A
30/01/01	Manchester Piccadilly	B	B	A	A	A
30/01/01	Manchester South	B	-	A	A	-
31/01/01	Manchester Town Hall	A	A	-	-	-
06/02/01	Middlesbrough	B	A	A	A	A
07/02/01	Newcastle Centre	B	A	A	B	A
12/02/01	Norwich Centre	C	A	C	D	A
13/02/01	Norwich Roadside	A	-	-	-	-
21/02/01	Nottingham Centre	A	A	A	A	A
08/01/01	Oxford Centre	A	A	A	-	-
18/01/01	Plymouth Centre	C	D	A	A	A
28/02/01	Preston	A	A	B	B	D
08/01/01	Reading	D	A	C	B	A
05/02/01	Redcar	B	A	A	A	A
12/02/01	Rotherham Centre	A	-	A	A	-
31/01/01	Salford Eccles	A	A	A	A	A
17/01/01	Sandwell West Bromwich	B	A	A	A	-

Date visited	Site	NOx	CO	SO_2	O_3	PM_{10}
22/02/01	S'thorpe	-	-	A	-	A
13/02/01	Sheffield Centre	A	D	A	B	A
13/02/01	Sheffield Tinsley	A	A	-	-	-
11/01/01	Southampton Centre	A	A	A	B	A
06/02/01	Southend-on-Sea	A	A	A	B	A
25/01/01	Stockport	A	A	A	-	A
22/01/01	Stoke-on-Trent Centre	B	A	A	B	A
07/02/01	Sunderland	-	-	A	-	-
05/02/01	Thurrock	A	A	A	A	A
22/02/01	Walsall Alumwell	A	-	-	-	-
22/01/01	Walsall Willenhall	A	-	-	-	-
07/02/01	West London	B	A	-	-	-
01/03/01	Wirral Tranmere	A	A	A	A	A
19/02/01	Wolverhampton Centre	B	A	A	C	A

- **The Belfast Centre site had just been reinstalled, an intercalibration was not possible. The analysers were tested and found to be operating satisfactorily.**

Grade	A	B	C	D	E
No of outliers	**204**	**48**	**13**	**7**	**1**

From the above table, it is clear that the vast majority of analysers (252 of the 273 analysers, 92%) in the network are functioning well. Of the remaining analysers, it is possible that data from the majority can be retained, but some investigation into the causes of the outliers needs to be undertaken. The following sections consider each pollutant in turn.

3 Ozone

The calibration of the ozone analysers was performed using NETCEN photometers certified against the Standard Reference Photometer (SRP), held at the National Physical Laboratory (NPL).

The results from 25 of the 46 analysers (54%) were found to be greater than 5% from the NETCEN standard at this intercalibration. The overall result is worse than the previous exercise, when 16 analysers were identified as outliers. Of the 25 outliers, 16 were minor grade B, the remaining nine were grade C.

Subsequent investigations revealed instrument response drift as the main reason for all but two of these outlying analysers. Ratification of the data from these 23 sites should be relatively straightforward.

22 of the 25 outliers showed an underread compared to the reference photometer. A possible reason for this could be losses to the sample manifold. This will be investigated fully at the next intercalibration

Action: netcen will carry out investigation of any outliers found, on site, to identify reasons for poor results.

The larger outlier identified at Bury Roadside (-43%) was attributed to a large drift in the instrument response, which should be correctable during ratification.

The outlier at Norwich Centre was caused by a failing UV detector lamp. Close examination of the dataset and the daily calibrations confirms that this has affected only a small portion of data, which will be rejected during ratification.

Despite the fact that a large number of outliers were identified, the vast majority were minor in nature. The ratification process should produce reliably scaled datasets, with only minimal consequences for data capture. However, it is somewhat worrying that so many outliers were identified during this exercise, however minor in nature. At the summer intercalibration, any analysers that are identified as outliers will be rigorously examined on-site to determine an exact cause for the poor performance.

4 Nitrogen Oxides

Twenty eight of the 66 analysers tested (43%) were identified as outliers, giving calculated values that were more than 10% from the network mean response. This result is worse than the previous intercalibration, when 30% of the analysers were found to be outliers.

Close investigation of the results showed that 21 of these outliers were of minor grade B, four of grade C and three of grade D.

The grade B outliers were all seen as a result of minor drifts or step changes in analyser response between scheduled LSO calibrations, which will be easily corrected during ratification, without any loss of data.

The analyser at London A3 and Reading were again seen to exhibit considerable differences in response when gas was introduced through the sample inlets, as opposed to the dedicated cylinder inlets. This may well have significant consequences for ambient data, as the results from the scheduled calibrations do not appear to accurately represent what the analyser samples from ambient air.

This phenomenon was also seen at Blackpool and Glasgow Kerbside, and to a lesser extent at Norwich Centre and Plymouth Centre.

Recommendation: The ESU responsible for these sites should undertake an investigation, to identify reasons for this behaviour, and effect repair

Data from all of these sites will be carefully examined during ratification, but it is possible that some data will need to be rejected as a result of these findings.

The outlier at Brighton Roadside appears to be due to a bad calibration with audit NO_2 gas, and it is unlikely that data will be rejected as a result.

Comparison of the network average results against the actual cylinder concentrations showed that the network overestimates NO concentrations by approximately 3% of actual concentrations, with a percentage standard deviation around this value of 4.9%. This is a good result which demonstrates that measurements are accurate, consistent and traceable to metrology standards.

The result of the network NO_2 intercomparison shows that the network appears to underestimate concentrations by an average of 6.6%, with a percentage standard deviation around this value of 5.5%. This result is significantly better than the previous intercomparison, which suggested NO_2 concentrations were underestimated by nearly 10%. These results demonstrate that measurements of NO_2 are accurate, consistent and traceable to metrology standards.

The NOx converters at three sites (5%) were found to have fallen below the 95% acceptance limit:

1. Coventry 93%
2. Manchester South 94%
3. Nottingham Centre 93%

These sites were also identified at outliers at the previous intercalibration. This is an improvement over the winter exercise, where four “repeat offenders” were highlighted.

The Coventry site had just been recommissioned following relocation and a major upgrade. The converter temperature had not been set high enough, and was adjusted prior to the publication of any data. No data will need to be rejected as a result.

The converters at Nottingham Centre and Manchester South are very close to acceptable performance, and will therefore be allowed to pass on this occasion. However, the ESU should continue to undertake three monthly converter tests to ensure optimal performance.

Recommendation: ESU to undertake three monthly converter tests at Nottingham Centre and Manchester South

The converters at a number of other sites were found to be on the borderline of acceptable performance: Blackpool, Brighton Roadside, Rotherham and West London all had converters at between 94.5 and 95% efficiency. While these analysers will be allowed to pass on this occasion, their performance will be carefully scrutinised at the next exercise.

5 Carbon Monoxide

Eight of the 57 analysers (14%) were identified as outliers. Five were classified grade B, one grade C and two grade D. This is somewhat worse than the previous exercise, when two analysers were found to be outside the acceptance limits.

The five grade B outliers were all seen as a result of minor drifts or step changes in analyser response between scheduled LSO calibrations, which will be easily corrected during ratification, without any loss of data.

The analyser at Birmingham Centre suffered a step change in zero response prior to the audit, which should be easily correctable during ratification, with no loss of data.

The analyser at Plymouth Centre appears to be exhibiting the same pressure sensitivity as the NOx analyser at the site.

The outlier at Sheffield Centre appears to be due to operator error during the audit visit. The analyser performance is acceptable, and no data should be lost as a result.

Comparison of the network average results against the actual cylinder concentrations showed that, overall, the network measures concentrations of CO to within 1% of actual values, with a percentage standard deviation of 3.5%. This is an excellent result, demonstrating that measurements are accurate, consistent and traceable to metrology standards.

6 Sulphur Dioxide

The analysers at six of the 57 sites (11%) were identified as outliers, giving calculated values that were more than 10% from the network mean response. Of these outliers, 3 were grade B, 2 were grade C and 1 was grade E. This result is better than the previous intercalibration, when 24% of the analysers were found to be outliers.

The outliers at Hove Roadside, London Brent and Preston were all seen as a result of minor drifts or step changes in analyser response between scheduled LSO calibrations, which will be easily corrected during ratification, without any loss of data.

The analyser at Norwich Centre underwent a step change in zero response prior to the audit. This will be easily correctable during ratification, and no data should be lost.

The analyser at Reading exhibited a difference in response when gas was introduced through the sample inlet, as opposed to the dedicated cylinder inlet. This may well have significant consequences for ambient data, as the results from the scheduled calibrations do not appear to accurately represent what the analyser samples from ambient air.

The analyser at Bury failed to respond to any calibration gases, and CMCU were notified immediately to initiate repair.

Comparison of the network average results against the actual audit cylinder concentrations showed that, overall, the network measures SO_2 concentrations to within 3%, with a percentage standard deviation of 4.6%. This is an excellent result, and demonstrates that measurements are accurate, consistent and traceable to metrology standards.

The efficiency of the hydrocarbon “kicker” was evaluated with a 1 ppm m-xylene cylinder. The kicker selectively removes hydrocarbons from the sample inlet prior to analysis. This is an important test, because m-xylene behaves in a similar manner to SO_2 when exposed to UV light, and could therefore interfere with the analyser response, if the kicker doesn't function properly.

To pass the test, the analyser must not respond by more than 1% (10 ppb) of the m-xylene cylinder concentration. However, it should be noted that this particular test is very demanding; typical ambient hourly maximum concentrations of this pollutant rarely exceed 50 ppb, and annual concentrations rarely exceed 5 ppb.

The following 9 analysers were significantly outside the required standard:

1. Birmingham Centre (25 ppb)
2. Bolton (19 ppb)
3. Bradford Centre (24 ppb)
4. Leicester Centre (18 ppb)
5. Manchester Piccadilly (20 ppb)
6. Manchester South (19 ppb)
7. Norwich Centre (86 ppb)
8. Rotherham Centre (28 ppb)
9. Sheffield Centre (18 ppb)

The kickers at Manchester Piccadilly, Manchester South, Norwich Centre and Rotherham Centre were also identified as outliers at the previous exercise.

These results are much better than at the previous intercalibration, when 22 analyser kickers were identified as outliers. The magnitude of the outliers at a number of sites was also lower; only the kicker at Norwich Centre continues to give cause for concern. It should be replaced by the ESU at the earliest opportunity.

Recommendation: ESU to replace the kicker at Norwich Centre

To put these results into perspective, at the expected maximum ambient concentrations of m-xylene (50ppb), the worst kicker would show an interference response of around 4 ppb.

In addition, there were 14 analysers that were just outside the 10ppb acceptance criteria (between 10 and 15ppb), these will be accepted as passes on this occasion, but their performance will be carefully checked at the next intercalibration, and remedial action recommended as necessary.

7 Particulates

Evaluation of the TEOM instrument k_0 calibration constants, using a series of pre-weighed filters, showed that all but two analysers were within the ± 2.5% acceptance limit.

The calculated k_0 for the analyser at Coventry Centre was a borderline outlier at –2.9% from the stated value. The performance of this analyser will be checked at the next audit visit, and remedial action taken if necessary.

The calculated k_0 for the analyser at Preston was –24% from the stated value. The test was repeated and confirmed, and CMCU contacted immediately to effect repair. The dataset from the analyser will be carefully examined during ratification, and data rescaled or rejected as appropriate. It is possible that some data will be lost as a result of this finding.

No significant flow errors or leaks were found at any of the sites.

8 Site Cylinder Concentrations

During the intercalibration, the concentrations of the on-site cylinders were evaluated using the audit cylinder standards. The calculated results showed that 20 of the 241 cylinders (~8%) appear to be outside the ±10% acceptance criterion. This is much better than the previous intercalibration, where 15% of the cylinders were found to be out of specification. The site cylinder evaluations are performed by calibrating the analysers with audit and site cylinder gas through the same inlet system, and using the conditioned site cylinder regulators, thus minimising any possible errors due to contaminated tubing or regulators.

2 NO cylinder outliers were identified. The Billingham result confirms the result from the previous intercalibration, and should be returned to NPL for replacement at the earliest opportunity. The outlier at Blackpool is most likely due to the pressure sensitivity issue, discussed earlier. Nevertheless the performance of this cylinder will be carefully checked at the next intercalibration.

Recommendation: NPL to replace the Billingham NO cylinder

13 NO_2 outliers were found. Of the outliers identified, the cylinders at Brighton Roadside and Bury Roadside give most cause for concern, as they were found to be 50% and 33% respectively different from their certified values. However, as NO_2 cylinders are not routinely used to scale NOx data, the requirement for replacement is not urgent. The calculated concentrations of these cylinders will be carefully checked at the next intercalibration.

3 SO_2 outliers were identified. The calculated concentrations of the cylinders at London Bexley, Port Talbot and Preston were all within 15% of their stated values, so no action is required at this time. However, the calculated concentrations of these cylinders will be carefully checked at the next intercalibration.

As with earlier exercises, the site cylinder concentrations evaluated at the on-site audit are not used to update the cylinder databases. This is because the certified values provided by the Calibration Laboratories at NPL and NETCEN have much better uncertainties associated with their calculations. The field calculation is used as a check to identify possible outlier cylinders, which can be subsequently assessed by returning the cylinder for re-certification.

All of the revised calculations will be carefully assessed at the next intercalibration exercise, and any recurring outlier cylinders will be reported to NPL.

9 Assessment of sampling inlets

During this intercomparison exercise, the potential losses of sample gas to the inlet systems were assessed, using audit cylinder gas.

At a scheduled fortnightly calibration, the LSO introduces gases into the analysers through dedicated, clean gas cylinder inlets. These calibrations are then used to scale raw data from the analysers.

Audit cylinder gases and site cylinder gases were introduced to the analysers at the sample inlet, and the responses compared to the previous LSO calibration, to determine any significant differences between the two methods.

The majority of the sites showed losses of less than 10% to the sample inlet, but the issue of losses to the sampling / calibration systems was noted as significant for one or more pollutants at the following sites:

1. Blackpool (NOx)
2. Glasgow Kerbside (NOx)
3. London A3 (NOx)
4. Norwich Centre (NOx)
5. Plymouth Centre (NOx/CO)
6. Reading (NOx)

The analysers were seen to exhibit pressure sensitivity when audit gas was introduced into the sample inlets. This meant that if the excess flow to the analysers were increased, even by a small amount, the analyser responses would increase, and vice versa. As a result, it is impossible to reliably estimate losses to the manifolds for the analysers at these sites.

In general, there are fewer incidences of sample gas losses to the inlet manifold, since the phenomenon was first observed.

Recommendation: ESU's are requested to ensure that they continue to pay particular attention to the cleaning and condition of sample inlet manifolds during the six monthly services.

10 LSO Audits

During the intercalibration, 37 of the 55 Local Site Operators were audited; to assess their performance in undertaking scheduled calibrations. As with previous audit exercises, the majority of LSO's undertake calibrations competently, and are very knowledgeable about the equipment used on site and procedures employed in the network. During the intercalibration, we have also undertaken a number of assessments of relatively new LSO's (for example at Southend and Blackpool), to ensure that their training has been successfully undertaken. These were very successful, with very few adjustments of their operating techniques required to fully conform to the Operator Manual.

This LSO audit exercise once again demonstrates that operators are generally competent, enthusiastic and knowledgeable about their sites, which is a major contributing factor in ensuring the continued high performance of the network.

11 Certification

Appended to this report is the Network Certificate of Calibration. This certificate presents the results of the individual analyser scaling factors on the day of the audit visit, as calculated by NETCEN using the audit cylinder standards, in accordance with our UKAS accreditation.

The results for NOx at London A3 Roadside and Reading have not been included on the certificate, as a result of these analysers poor performance. For reference, The zero responses and calibration factors are reproduced below:

Site	Pollutant	Zero response	Calibration Factor
London A3 Roadside	NOx	68	3.949
	NO	57	4.169
Reading	NOx	39	7.163
	NO	29	7.120

12 Summary

The intercalibration exercise has demonstrated its value as an effective tool in determining overall site performance and assessing the reliability and traceability of air quality measurements from a large scale network. The results from this intercalibration will be used to assess data quality during the ratification of the network datasets for the 6-month period July-Dec 2000.

Appendices

CONTENTS

Appendix 1
Certificate of Calibration