

Summary of Laboratory Performance in WASP NO₂ Proficiency Testing Scheme for Rounds 105-113.

Reports are prepared by HSL for BV/NPL on behalf of Defra and the Devolved Administrations.

Background

The Workplace Analysis Scheme for Proficiency (WASP) is an independent analytical proficiency-testing (PT) scheme, operated by the Health and Safety Laboratory (HSL). WASP offers a number of test samples designed to test the proficiency of laboratories undertaking analysis of chemical pollutants in workplace and ambient air. One such sample is the WASP NO₂ test sample type that is distributed to participants in a quarterly basis.

WASP NO₂ PT forms an integral part of the UK NO₂ Network's QA/QC, and is a useful tool in assessing the analytical performance of laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM). With consent from the participating laboratories, HSL provides summary proficiency testing data to the LAQM Helpdesk for hosting on the web-pages at <http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html>

The WASP scheme is operated independently by HSL. The cost of operating the WASP is borne by the laboratories, which pay an annual fee to HSL.

Defra and the Devolved Administrations advise that diffusion tubes used for Local Air Quality Management should be obtained from laboratories that have demonstrated satisfactory performance in the WASP scheme.

For this reason, although WASP remains an independent proficiency-testing scheme, laboratory performance in WASP is also assessed by NPL in conjunction with separate data from the Field Intercomparison Exercise carried out at Marylebone Road, central London. The information is used to help the laboratories to identify if they have problems and may assist devising measures to improve their performance. This forms part of work for Defra and the Devolved Administrations under the Local Air Quality Management Services Contract.

This information will be updated on a quarterly basis following completion of each WASP PT round. The posting of reports to schedule is dependent on the laboratories sending their results promptly to HSL.

WASP NO₂ PT Scheme overview

Purpose of scheme

The WASP performance testing scheme uses artificially spiked Palmes type diffusion tubes to test each participating laboratory's analytical performance on a quarterly basis. Such tubes are not designed to test other parts of the measurement system e.g. sampling. Every quarter, roughly January, April, July and October each year, each laboratory receives four diffusion tubes doped with an amount of nitrite, known to HSL, but not the participants. At least two of the tubes are usually duplicates, which enables precision, as well as accuracy, to be assessed. The masses of nitrite on the spiked tubes are different each quarter, and reflect the typical analytical range encountered in actual NO₂ ambient monitoring in the UK when using such diffusion tubes.

Preparation of test samples

Diffusion tubes are spiked using a working nitrite solution prepared from a stock solution. The concentration of this stock solution is initially assayed using a titrimetric procedure. All steps in the subsequent test sample production process, involving gravimetric and volumetric considerations, are undertaken using calibrated instruments employing traceable standards. As an additional cross check, 12 spiked Palmes tubes are picked at random from each spike loading level and submitted to a third party laboratory which is accredited to ISO 17025 to undertake this analysis using an ion chromatographic procedure.

In summary, the tube spiking precision is calculated to be better than 0.5 %, expressed as a standard deviation, and this is derived from repeat gravimetric checking of the pipette device used to spike the test samples. The calculated spike values, derived from titrimetric, gravimetric and volumetric considerations, are found to be typically within ± 3 % of results obtained by the third party laboratory using an ion chromatographic analytical procedure.

Scheme operation

The participants analyse the test samples and report the results to HSL. HSL assign a performance score to each laboratory's result, based on how far their results deviate from the reference values for each test samples. The reference values are best estimates of the levels of nitrite doped onto the test sample tubes. At the completion of the round, laboratories receive a report detailing how they have performed and how their results relate to those of their peers.

Performance scoring

Changes to Scoring System as reported on the LAQM website

The z-score system is used by HSL to assess the performance of laboratories participating in the WASP NO₂ scheme. Information on the interpretation of the z score is provided below.

It was proposed however that HSL would migrate to an alternative scoring scheme, which is commonly used elsewhere in their WASP scheme for other PT services. In anticipation of this proposed migration, laboratory summary performance, previously reported on the LAQM website (Rounds 105 – 109), is included in this report based upon the z-score system.

HSL has decided, upon review, to maintain the z-score system, primarily due to the fact that it is a more readily understandable scoring system when viewed by a wider audience. Hence, going forward, laboratory summary performance, to be reported on the LAQM website, will be based upon this z-score system.

Key changes to the scoring system include:

- All monthly performance scores are reported and the previous WASP scoring system, which allowed the lowest performing round result (best 4 out of 5) to be dropped, is no longer used.

- The use of the z-score allows new entrants or those leaving the WASP scheme to be assessed as the score is not based on a rolling performance indicator.
- All results from UK laboratories participating in the WASP scheme are now reported (previously laboratories that did not demonstrate satisfactory performance were not included).

Z-Score performance

Performance scores are currently based upon the z-score statistic, a widely used scoring system employed in chemical proficiency testing. More detailed information is available at <http://www.hsl.gov.uk/centres-of-excellence/proficiency-testing-schemes/wasp.aspx> where the latest version of the WASP participant handbook (May 2011) can be downloaded.

The z-score, z_{score} , may be defined as:

$$z_{\text{score}} = \frac{(x_{\text{lab}} - \bar{x}_{\text{ref}})}{\sigma_{\text{ref}}}$$

where;

x_{lab} = participant result from a laboratory

\bar{x}_{ref} = reference result (here it is the calculated nitrite spike value)

σ_{ref} = reference standard deviation (currently set at 7.5 % of \bar{x}_{ref})

Performance score interpretation

A z_{score} may be interpreted as:

$z_{\text{score}} < \pm 2$ – satisfactory laboratory result

$z_{\text{score}} \geq \pm 2$ and $< \pm 3$ – questionable (warning) laboratory result

$z_{\text{score}} \geq \pm 3$ – unsatisfactory laboratory result

As a general rule of thumb, provided that a laboratory does not have systematic sources of bias in their laboratory measurement system, then on average, 19 out of every 20 z-scores should be $< \pm 2$. In this scheme each laboratory receives 4 test samples per round and therefore submits 4 z-scores per round. Hence over 5 rounds laboratories would receive 20 test samples and report 20 z-scores.

Therefore over a five round window, one would expect that 95 % of results should be $< \pm 2$. If this percentage is substantially lower than 95 %, within this five round window, then one can conclude that the laboratory in question may have significant systematic sources of bias in their assay.

A summary of the WASP performance for each laboratory participating in the scheme is provided in Table 1. This table provides the percentage of results where the z-score was between -2 and +2 which is deemed to be a satisfactory z-score.

Contacts for HSL WASP scheme

Further **specific** information on the WASP NO₂ PT scheme is available from HSL by contacting the proficiency testing team at proficiency.testing@hsl.gov.uk or at 01246 218553.

For **general** questions about the scheme within the context of LAQM activities please contact Nick Martin at NPL on 0208 943 7088 or nick.martin@npl.co.uk.

Table 1: Laboratory summary performance for WASP NO₂ PT rounds 105 - 113

The following table lists those UK laboratories undertaking LAQM activities that have participated in recent HSL WASP NO₂ PT rounds and the percentage (%) of results submitted which were subsequently determined to be **satisfactory** based upon a z-score of $< \pm 2$ as defined above.

WASP Round	WASP R105	WASP R106	WASP R107	WASP R108	WASP R109	WASP R110	WASP R111	WASP R112	WASP R113
Round conducted in the period	April – June 2009	June – August 2009	Oct – Dec 2009	Jan – March 2010	April – June 2010	June – August 2010	Oct – Dec 2010	Jan -March 2011	April - June 2011
Aberdeen Public Analysts	100 %	75 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Bristol City Council	100 %	100 %	100 %	75 %	100 %	100 %	100 %	100 %	100 %
Cardiff Scientific Services	100 %	100 %	100 %	100 %	50 %	100 %	75 %	100 %	100 %
Edinburgh City Council	75 %	100 %	100 %	100 %	100 %	75 %	100 %	100 %	100 %
Environmental Services Group, Didcot (formerly Bureau Veritas Laboratories, Glasgow) [1]	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Exova (formerly Clyde Analytical)	75 %	75 %	100 %	100 %	50 %	50 %	100 %	100 %	100 %
Glasgow Scientific Services	75 %	100 %	100 %	50 %	100 %	100 %	100 %	100 %	100 %
Gradko International [2]	100 %	100 %	100 %	100 %	87.5 %	100 %	100 %	100 %	100 %
Environmental Services Group, Didcot (formally Harwell Scientifics) [1]	100 %	50 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Kent Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	100 %	50 %	100 %
Kirklees MBC	25 %	100 %	75 %	100 %	100 %	100 %	0 %	100 %	0 %
Lambeth Scientific Services	75 %	100 %	0 %	50 %	100 %	100 %	100 %	50 %	25 %
Lancashire County Analysts [3]	75 %	75 %	100 %	100 %	75 %	50 %	100 %	75 %	-
Milton Keynes Council	75 %	100 %	75 %	100 %	25 %	50 %	100 %	100 %	75 %
Northampton Borough Council	100 %	100 %	75 %	100 %	100 %	100 %	100 %	100 %	100 %
South Yorkshire Council Laboratory [4]	100 %	75 %	100 %	25 %	-	-	-	-	-
South Yorkshire Air Quality Samplers [5]	-	-	-	-	100 %	100 %	100 %	100 %	100 %
Staffordshire County Council	100 %	75 %	100 %	100 %	100 %	50 %	100 %	100 %	100 %
Tayside (formerly Dundee CC)	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Walsall MBC [6]	100 %	100 %	-	-	100 %	100 %	100 %	-	-
West Yorkshire Analytical Services	75 %	100 %	100 %	100 %	100 %	100 %	100 %	75 %	75 %

[1] Bureau Veritas laboratory and Harwell Scientifics now part of ESG Group. NO₂ analysis now carried out at ESG laboratory facility in Didcot.

[2] Gradko International - Participant subscribes to two sets of test samples (2 x 4 test samples) in each WASP PT round.

[3] Lancashire County Analysts - no longer involved in NO₂ diffusion tube measurements from R113.

[4] South Yorkshire Council Laboratory - no longer involved in NO₂ diffusion tube measurements from R109.

[5] South Yorkshire Air Quality Samplers - new participant from R109.

[6] Walsall MBC - Results for WASP R107, R108 and R112 not submitted. No longer involved in NO₂ diffusion tube measurements from R113.