

Monitoring Quick Guide 3

version 1.0

SM-QG3 - Applying BS EN 14181 – Stationary Source Emissions; Quality assurance of automated measuring systems

1. Scope

This Quick Guide describes the requirements for installations subject to the requirements of *BS EN 14181 – Stationary Source Emissions – Quality assurance of automated measuring systems* (AMS). In Scotland we refer to AMS as Continuous Emission Monitoring systems (CEMs).

2. Practical Guidance

2.1 Scope and application

BS EN 14181 applies to:

- Installations which fall under the Waste Incineration Directive (WID) and Large Combustion Plant Directive (LCPD).
- CEMs used for compliance monitoring, and permanently installed at WID and LCPD installations.
- Only applies to the CEMs themselves and not the data collection and recording systems used with CEMs.

2.2 Structure of BS EN 14181

BS EN 14181 specifies three quality assurance levels (QALs) and an annual surveillance test (AST). These are:

QAL1	A procedure to demonstrate that the CEM is suitable for the intended purpose before installation, by meeting required performance standards and the uncertainty allowances specified in EU Directives.
QAL2	A procedure to calibrate the CEM using SRMs once it has been installed and then verify whether it still meets the required uncertainty allowances.
QAL3	A procedure to maintain and demonstrate the required quality of the CEM during its normal operation by checking the zero and span readings.
AST	A procedure to evaluate the CEM to show that it continues to function correctly and the calibration function is still valid.

2.3 QAL 1

2.3.1 Requirements for new CEMS

The first level of quality assurance, QAL1, demonstrates the potential suitability of the CEM before it is installed on a stack. CEMs certification schemes (e.g. Environment Agency of England & Wales Monitoring Certification scheme (MCERTS) or German TUV/UBA certification scheme) at an appropriate certification range (see Quick Guides 1 and 2) is taken as evidence of compliance with the QAL1 requirements. BS EN 15267-3 – Air Quality – Certification of automated measuring systems compliance is seen as being suitable for QAL1, certification schemes use this standard as the basis for their schemes.

QAL1 provides a means of demonstrating the CEMs will meet the uncertainty requirements specified in the WID and LCPD. Certification of CEMs is the means of demonstrating the same requirements, and therefore certification of CEMs is a means of demonstrating QAL1 requirements.

2.3.2 Requirements for existing CEMs

The requirements of Quick Guides 1 and 2 apply as a starting point. If the CEMs already fitted to installations do not meet the requirements specified in QAL1, then the operator may keep the CEMs for the rest of their design lives so long as the CEMs still meet the requirements of QAL2, the AST and QAL3.

2.3.3 Responsibilities

- Operators of installations under the WID and LCPD are responsible for ensuring the CEMs comply with the QAL1 requirements, and that all aspects of QAL2, the AST and QAL3 are fulfilled.
- Test laboratories are responsible for reporting whether CEMs are QAL1 compliant, when reporting the results of QAL2 and AST exercises.
- Any organisation (operators, test laboratories, equipment suppliers, etc) may perform the functional tests specified in Annex A of BS EN 14181, as long as the organisation meets the requirements of this Annex, and can demonstrate competence in performing the functional tests.

2.4 QAL 2

2.4.1 Requirements of QAL2

QAL2 consists of a set of functional tests to check that the CEMs are operating in a satisfactory manner and a set of standard reference method (SRM) repetitions as a means of verifying the performance of the CEMs, and calibrating them if necessary by applying a calibration function.

2.4.2 Frequency of QAL2s

The QAL2 procedures are carried out:

- When the CEM is installed;
- then at least every three years (under the WID) or five years (under the LCPD);
- whenever there is a significant change in plant operation which changes the emissions;
- after a failure of the CEM so that significant repair is required and affects calibration;
- after a significant upgrade or other significant change to the CEM affecting calibration.

Any changes that do not affect the calibration of the CEM will not require a repeat of the QAL2 procedure.

2.4.3 Default requirements for the functional tests

The test laboratory performing the SRMs for QAL2 is responsible for verifying and reporting the results of the functional tests.

- The functional tests must be performed before the SRMs (within four weeks is recommended).
- The preferred option is that the test laboratories should perform the functional tests.
- If not, the second preferred option is that the test laboratory witnesses the functional tests, if these are performed by another party, such as the CEMs supplier or process operator.
- If either of the first two preferred options are impracticable to arrange, then the test laboratory may present verifiable evidence in the test report, showing that the functional tests have been performed not earlier than four weeks before the SRMs. However, this option should be a last resort and the test laboratory must provide justification for this option.

2.4.4 SRM tests

BS EN 14181 specifies that the QAL2 tests must be performed over at least three days, taking **at least** 15 measurements.

- These measurements must be spread out over a working day and there must be at least one hour between each SRM repetition.
- If the test laboratory does not comply with these requirements, then the test laboratory must provide justification for this, and demonstrate that the test results are representative.
- The test laboratory must show that the CEMs read zero when the emissions are zero.

2.4.5 SRM results

The SRM results will typically fall into three classes.

- A wide spread of data. The difference between the highest and lowest values is more than 15% of the ELV. Such results are analysed by linear regression (Method A in BS EN 14181).

- A cluster of data, where the difference between the highest and lowest values is less than 15% of the ELV. The results are analysed by averaging the cluster to calculate a calibration factor (Method B in BS EN 14181).
- A low level cluster of data, where the results are not more than the 95% confidence interval of the daily average ELV. In such cases, a calibration factor calculated by Method B is unreliable (See 2.4.6)

2.4.6 Low level clusters

If there are low level clusters and historical data predicts this, then the following procedures apply:

- SRMs are used to verify that the CEMs are functioning and provide a measurement within an acceptable range. The difference between the average of the SRM results and the CEM results should not be more than half the 95% confidence interval of the daily average ELV.
- The number of repetitions of the SRMs may be reduced to three to five repetitions, over one day.
- The CEMs may be calibrated using surrogates.

2.4.7 Extrapolating the calibration range.

The highest value of the SRM (+10%) dictates the valid calibration range. This range may be extrapolated to the ELV as follows:

- Measuring the CEMs reading using a surrogate with a known value at the ELV.
- The value of the CEM for the surrogate must be within the 95% confidence interval of the daily average ELV.
- Any readings within the extrapolated range are then valid; however, the proportion of readings within the extrapolated range is limited (refer to 6.5 of BS EN 14181).

2.4.8 Test report

Section 6.8 and 8.6 of BS EN 14181 specifies the requirements for test reports for QAL2 and AST monitoring results respectively. If the test laboratory does not follow all the requirements in BS EN 14181, then the test laboratory shall justify any deviations.

2.4.9 Responsibilities

- The test laboratory is responsible for performing the SRMs for QAL2 and the AST, and for providing verifiable evidence that the functional tests have been performed.
- The test laboratory performing the QAL2 and AST exercises shall be accredited to BS EN 14181 under UKAS accreditation to ISO/IEC 17025 and DD CEN/TS 15675.

- The process operator of the regulated installation is responsible for ensuring that the QAL2 and AST reports are performed when required, and for submitting the reports to the Scottish Environment Protection Agency.

2.5 QAL 3

2.5.1 Requirements

The QAL3 procedure ensures that the CEM remains within the required specifications during continued use. QAL3 achieves this by requiring the process operator to regularly measure the drift and precision of the CEM. This data is then plotted using control charts – such as Shewhart or CUSUM charts – and then using the outputs of these charts to determine when the CEM needs maintenance. The frequency of the drift measurements depends on the maintenance interval determined during the certification performance tests, and can be anything from one week to several months. The use of CUSUM charts, however, requires drift tests to be carried out at least weekly. In many CEMS the QAL 3 tests are conducted automatically within an instrument and therefore occur more frequently.

In order to comply with the QAL3 requirements, all CEMs must have the means to allow operators and test laboratories to perform regular zero and span tests. If the CEMs do not have such a means, then they cannot comply with the QAL3 requirements of BS EN 14181.

2.5.2 Responsibilities

- The process operator is responsible for implementing and applying a procedure for QAL3.
- The test laboratory shall provide evidence of the operator's QAL3 procedure within QAL2 and AST test reports.

2.6 Annual surveillance test

The annual surveillance test (AST) is a mini-QAL2 test. Its key objective is to check whether the calibration function determined during the QAL2 tests is still valid. The AST consists of the same functional tests as those used in QAL2, but the calibration function is checked by using a smaller number of repetitions of the SRMs (typically five repetitions). If the calibration function is still valid, then no further action is required. If the AST shows that the calibration function is no longer valid, then a full QAL2 is required.

In order to provide for the functional tests, among other things, a CEM must have the means for performing linearity tests, once the CEM has been installed.

3. Further information

3.1 Quick Guides

- SM-QG-01 Selecting continuous emission monitoring systems (CEMs)
- SM-QG-02 CEMs for WID applications.
- SM-QG-06 Calibrating CEMs for particulate monitoring

3.2 Environment Agency Technical Guidance Notes

- TGN M2 – Monitoring of stack emissions to air
- TGN M20 – Quality assurance of continuous emissions monitoring systems

4. Feedback

Any comments or suggested improvements to this note should be e-mailed to Duncan Stewart at duncan.stewart@sepa.org.uk.

5. Acknowledgments

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