



**VGB Working Group**  
**Emissions Monitoring<sup>1)</sup>**

**Comments on the Quality Assurance Standard EN 14181**

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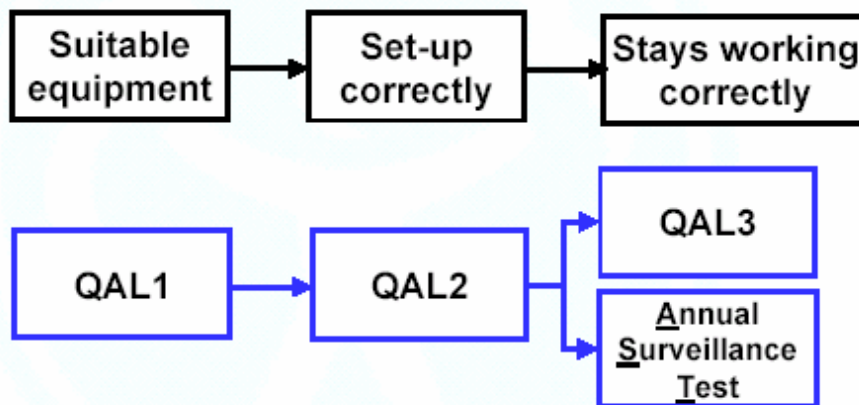
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## 1 Background

The new CEN standard (EN 14181)<sup>1</sup> defines three Quality Assurance Levels - QAL1, QAL2 and QAL3 - and an Annual Surveillance Test (AST). The basic structure of the QA process is shown in the flow diagram.



Source: Gould, R., 'QA of AMS', MCERTS Conference, Bretby, 2003

The Operator has the following general responsibilities:

- Installation of compliant equipment to give a representative measurement (QAL1)
- In-situ calibration of CEMs using an accredited test organisation (QAL2)
- Annual check of the in-situ calibration using an accredited test organisation (AST)
- Perform ongoing Quality Assurance based on regular zero & span drift checks (QAL3)
- Retention of QAL2, QAL3 and AST reports and ongoing maintenance of records
- Checking of hourly averages against the valid calibration range (weekly)

The applicable Emission Limit Values (ELVs) for NO<sub>x</sub>, SO<sub>2</sub> and dust are required in order to implement the standard for large combustion plant, in addition to the confidence limits defined in the Large Combustion Plant Directive (LCPD), i.e., 20% for NO<sub>x</sub> and SO<sub>2</sub>, 30% for dust.

<sup>1</sup> EN 14181:2004 Stationary source emissions. Quality assurance of automated measuring systems.

## 2 Introduction

The new standard is welcome in that it provides a step change in the Quality Assurance applied to Continuous Emissions Monitoring Systems (CEMs), although the requirements will require significant additional investment from industry in relation to purchase, relocation and proving of CEMs. However, there are a number of inconsistencies in the specified approach and some potentially impractical/costly requirements that should be amended when the standard is reviewed, as discussed below. From the VGB perspective, the concerns are serious enough to justify an early revision of the standard.

Regarding low load factor plant, it is inappropriate to run the plant, for reasons of both cost and practicality, in order simply to prove the CEMs. By their very nature, these plant have unpredictable load schedules and do not emit for substantial periods of time and it should be made clear that the standard does not apply in these circumstances. For instance, a guideline of 1250 operating hours per annum could be referenced, below which the standard would not apply. This is based on the LCPD monitoring derogation for plant with a life of 10,000 hours, across the period 2008 to 2016.

## 3 Quality Assurance Level 1 (instrument type and location)

It is unreasonable to expect Operators to conduct a full uncertainty analysis for each analyser, for the following reasons:

- the statistical approach is too complicated for site use
- there is confusion regarding the list of CEM performance parameters that should be considered under ISO 14956
- performance data are not always readily available in the detail required and many assumptions have to be made
- a full uncertainty analysis should include the representativeness of the measurement
- individual Member States have implemented a simplified approach that requires the certified range to be less than  $2.5 \cdot ELV^2$  provided that the certification field trial is conducted on a suitable (similar) process plant. This is broadly equivalent to the full uncertainty assessment based on performance parameters.

**VGB supports the simple QAL1 approach that requires the certified range to be less than  $2.5 \cdot ELV$  for large combustion plant. This makes use of the performance testing conducted within the recognised certification/acceptance schemes.**

## 4 Quality Assurance Level 2 (In-situ calibration using site test data)

### 4.1 Requirement to conduct a QAL2 calibration

- there should be no requirement to conduct an additional QAL2 for a second fuel when this is used for a small proportion of the time or as a small proportion of the thermal input to the plant, e.g., oil firing during start-up of a coal fired plant when it would not be practical to obtain stable operating points.

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<sup>2</sup> The 48h ELV for existing plant and the 24h ELV for new plant.

- the requirement to conduct QA tests on the CEMs will result in scheduled unavailability of the CEMs and this should not count towards the reported unavailability.
- when the emission concentrations are very low, and it is clearly both impractical and unnecessary to conduct a QAL2, it should be possible to use reference materials alone for the calibration.

**VGB supports the flexible interpretation of the standard such that the Competent Authorities in the Member States can determine the requirements for support firing, low emission plant and CEM unavailability. Low load factor plant, operating below a threshold of, for example, 1250 hours per annum, should not be subject to the requirements of the standard.**

#### 4.2 Valid Calibration range

Many of the issues associated with QAL2 relate to the valid calibration range. Currently, this can be extended by only 10% above the maximum concentration measured during the test campaign. This is completely impractical - although the standard mentions the possibility of extending the range using reference materials (gas standards and optical filters for dust), the conditions under which this is allowed are unclear.

- the limit of a 10% extension encourages Operators to generate the maximum pollution when calibrating the CEMs in order to avoid later non-compliance on the CEMs range, e.g., by burning a high sulphur fuel – this is clearly unacceptable and the use of reference gases should be allowed to extend the valid range.
- the ability of the Operator to provide a realistic range of plant data during the trial is limited since the plant should be operating normally according to the standard. Whilst this is a sensible condition, it demonstrates that a limit of 10% is inadequate. It also calls into question the need to conduct so many measurements.
- the 10% limit is applicable to hourly averages. There may be high readings within an hourly average when the CEMs may be reading peak values well above the ‘valid’ range due to, for example, high NO<sub>x</sub> caused by combustion difficulties or higher instantaneous dust levels produced when a bag filter is operating on a normal cycle – this is clearly inconsistent. The instrument range advised by the standard is 2.5\*ELV and it should be possible to extend the valid calibration range to at least this value.
- the linearity functional test should be used for extension of the valid calibration range, although the criteria for passing the linearity test should be revisited.
- when concentrations are lower than 30% of ELV, the calibration should be based on zero and span data rather than measured data, as allowed in individual Member States, since it is neither necessary nor meaningful to apply the full QAL2 approach.

**VGB supports the explicit extension of the calibration range, based on the linearity functional test, up to at least 2.5\*ELV. The calibration for plant with very low emissions should be based on reference materials.**

#### 4.3 Calibration line

Issues surrounding the development of the calibration line are listed below:

- incorporation of a measured ‘zero’ value should be allowed so that a sensible calibration line can be constructed when most of the concentration data are at a high level – otherwise the line can have an unrealistic slope.
- in the case of in-situ gas concentration measurements, sampling from the probe volume for the Test measurements could be beneficial.

- when the plant emission is close to the ELV there is a concern that it is difficult to pass the variability test, particularly for dust monitors – the allowable variability for dust should be revisited.

**VGB supports the flexible interpretation of the standard such that the Competent Authorities in the Member States can determine the requirements for plant with very low emissions and those with dust emissions close to the ELV. The standard should be clarified so that zero points can be included to improve the quality of the calibration.**

#### 4.4 Peripheral measurements

Peripheral measurements are those that are required for correction of the pollutant concentrations to standard reference conditions (6% oxygen in the dry flue gases at 0°C, 1013.25 mbara for coal fired plant). Gas concentration measurements require the local oxygen concentration and, if measured in-situ, the local water vapour content. Dust measurements require oxygen and water, as for gases, and also the local temperature and pressure.

The standard (correctly) assumes that the peripheral measurements can be used to correct measurements at the test location to the conditions at the CEM location, i.e., it allows for genuine variations in these parameters between the two locations. These variations may be caused, for example, by differences in oxygen content in existing large installations where the CEM is placed in an upstream duct and the test measurement is located, of necessity, further downstream. Or there may be unavoidable variations at the two measurement planes. In general terms, it is clearly inappropriate to force the CEM peripheral reading to match the Test peripheral reading. Nor is it clear how a QAL2 calibration line would be applied for a peripheral measurement.

- a functional check of the peripheral measurements should be sufficient to ensure that the CEM peripherals are reading correctly. A QAL2 calibration line is not required, although all of the peripheral measurements will be obtained during the QAL2 data gathering.
- default factors are appropriate for water vapour content on large, fossil fuel, fired combustion plant since the water vapour content can be calculated, from plant measurements, with at least an equivalent level of accuracy as the measurement techniques.

**VGB supports the view that QAL2 calibrations should not be conducted for peripheral measurements since this is not physically meaningful. Functional checks should be sufficient to ensure that the instruments are performing correctly. Default factors are recommended for water vapour when firing well characterised fuels.**

## 5 Quality Assurance Level 3 (ongoing performance)

The following points relate to the determination of zero and span drift and the comparison of the drift with control limits.

- the uncertainty of the analyser when operating in-situ (s-AMS) is difficult to determine (see response to QAL1) and it is therefore difficult to determine the control limits in the way that the standard recommends. In particular, it is unclear which of the uncertainty parameters should be combined.

- the standard approach tends to penalise the analysers with the best performance.
- a simpler, and fairer, approach would be to express the control limits as a fixed percentage of the ELV - action limit at  $\pm 20\%$  ELV ( $\pm 10\%$  span) and warning limit at  $\pm 10\%$  ELV ( $\pm 5\%$  span).
- There is confusion regarding the normal auto-calibration of the analysers, using reference materials, and the in-situ calibration required under QAL2. Clarification of the terms and the wording used in the standard is required.
- Clarification regarding the implementation of the QAL2 calibration factors is required, e.g., within analyser software or in the data management system.
- Auto calibration is a drift correction and should be allowed as a QAL3 procedure, although absolute cumulative drift may still be recorded.

**VGB supports a simple approach to QAL3 that eliminates the need for uncertainty analysis to be conducted by the Operator and advocates that the control limits are specified as a fixed percentage of the ELV. User determined auto-calibration should be allowed to maximise the accuracy of the reported concentrations whilst recording the underlying cumulative drift.**

## **6 Annual Surveillance Test (calibration check)**

- when an additional QAL2 calibration is required, e.g., due to a change in the fuel or the process, it should be sufficient to conduct an AST in order to check that the calibration line remains valid.
- upon failure of an AST, a temporary adjustment of the calibration line should be allowed, pending a full QAL2 within the following 6 month period..
- on-site cross-interference testing should not normally be required within the functional checks performed in advance of an AST, provided that the appropriate cross-interferences are addressed within the certification process.
- the accredited laboratory should be able to audit the functional tests performed by, for example, the instrument companies or the Operator.
- the points made in relation to QAL2, e.g., extension of the valid calibration range using reference materials, also apply to the AST.
- the standard makes no allowance for the uncertainty associated with the Standard Reference Methods. This is a major weakness, that should be addressed, and introduces a further uncertainty when using different Test organisations to conduct QAL2s and ASTs.

**VGB supports the use of an AST in circumstances when an additional QAL2 may be required, in order to check that the calibration line remains valid. Flexibility is required when applying functional checks. The uncertainty of the test methods should be addressed explicitly.**